SD427
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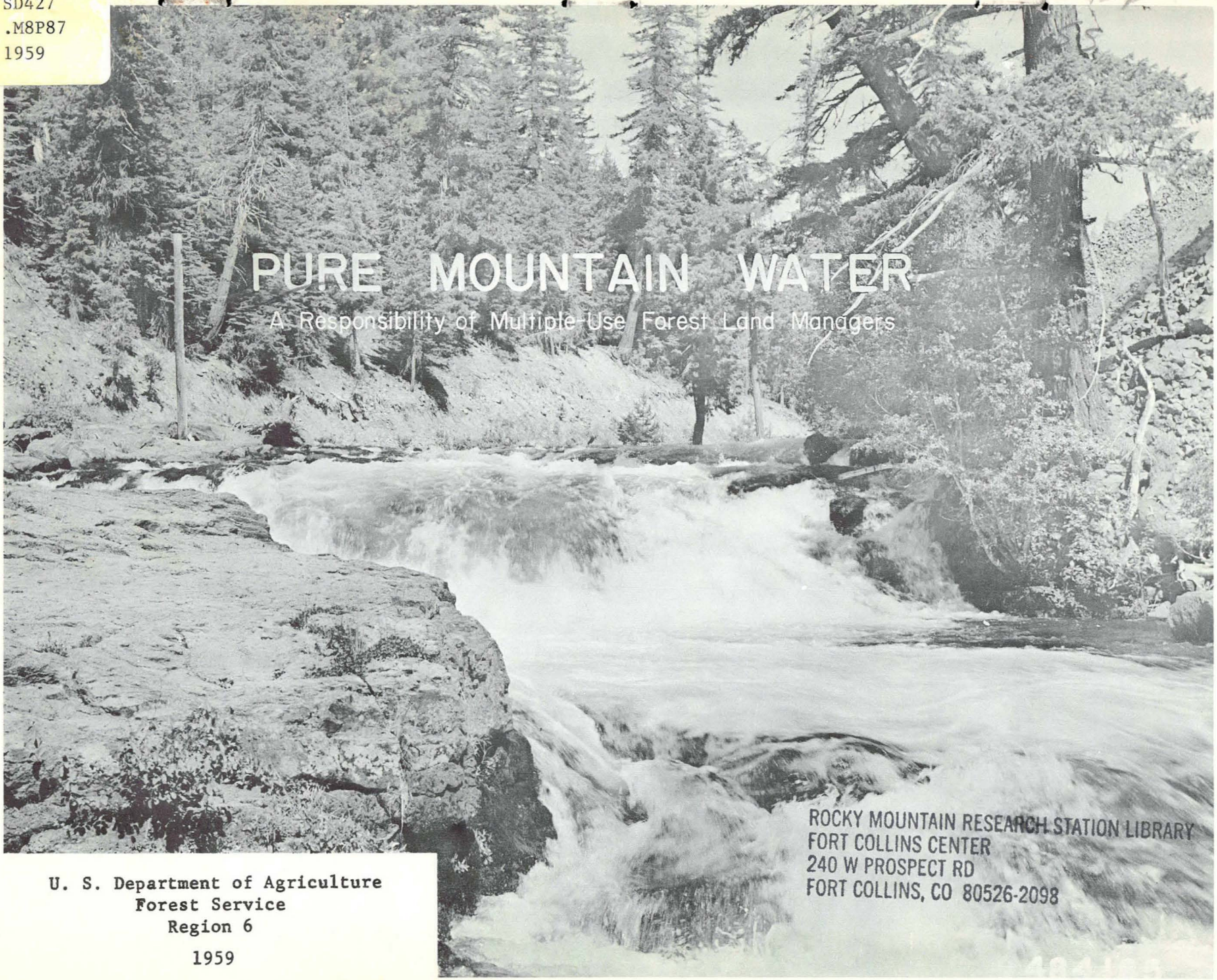

PURE MOUNTAIN WATER

A Responsibility of Multiple-Use Forest Land Managers

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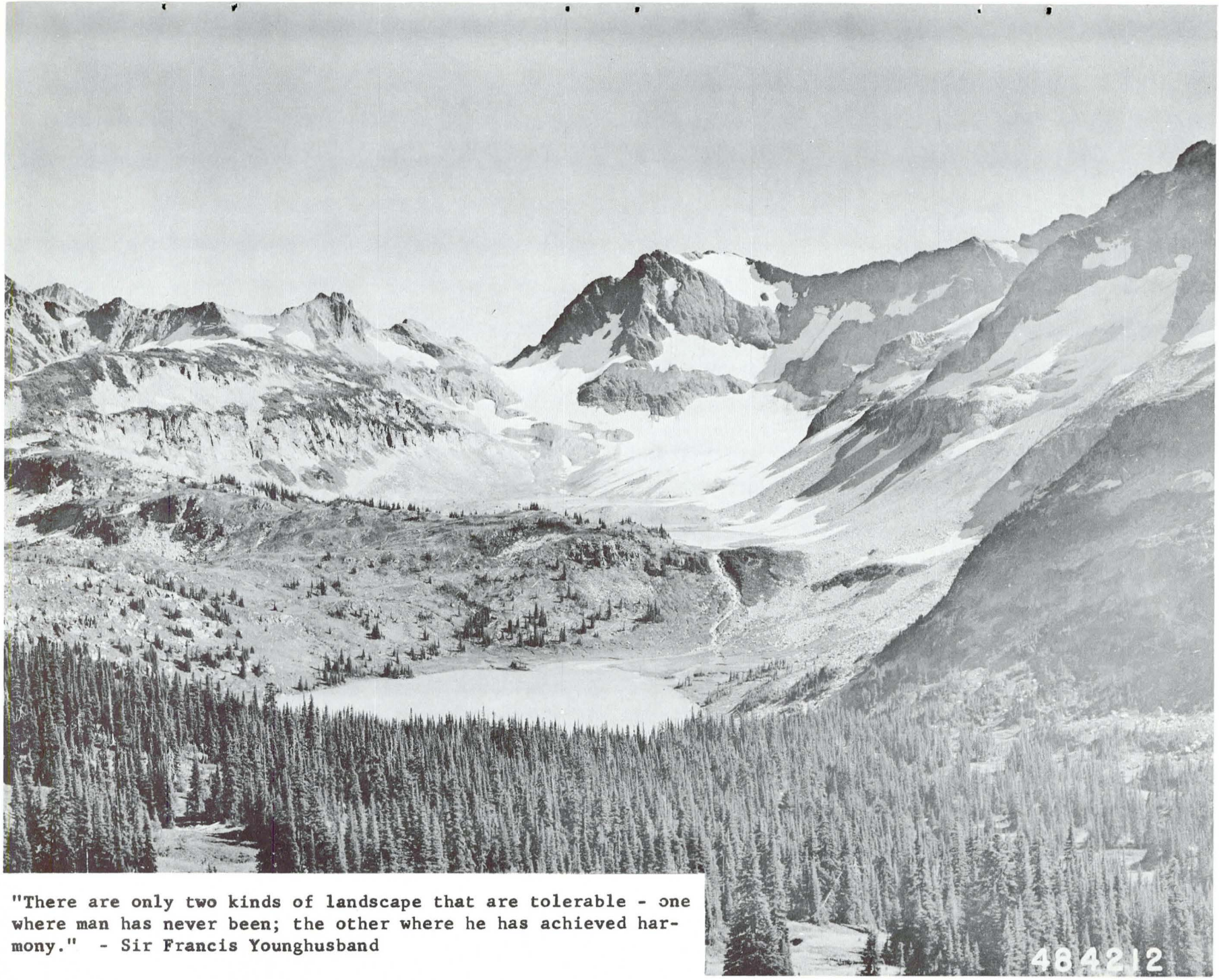
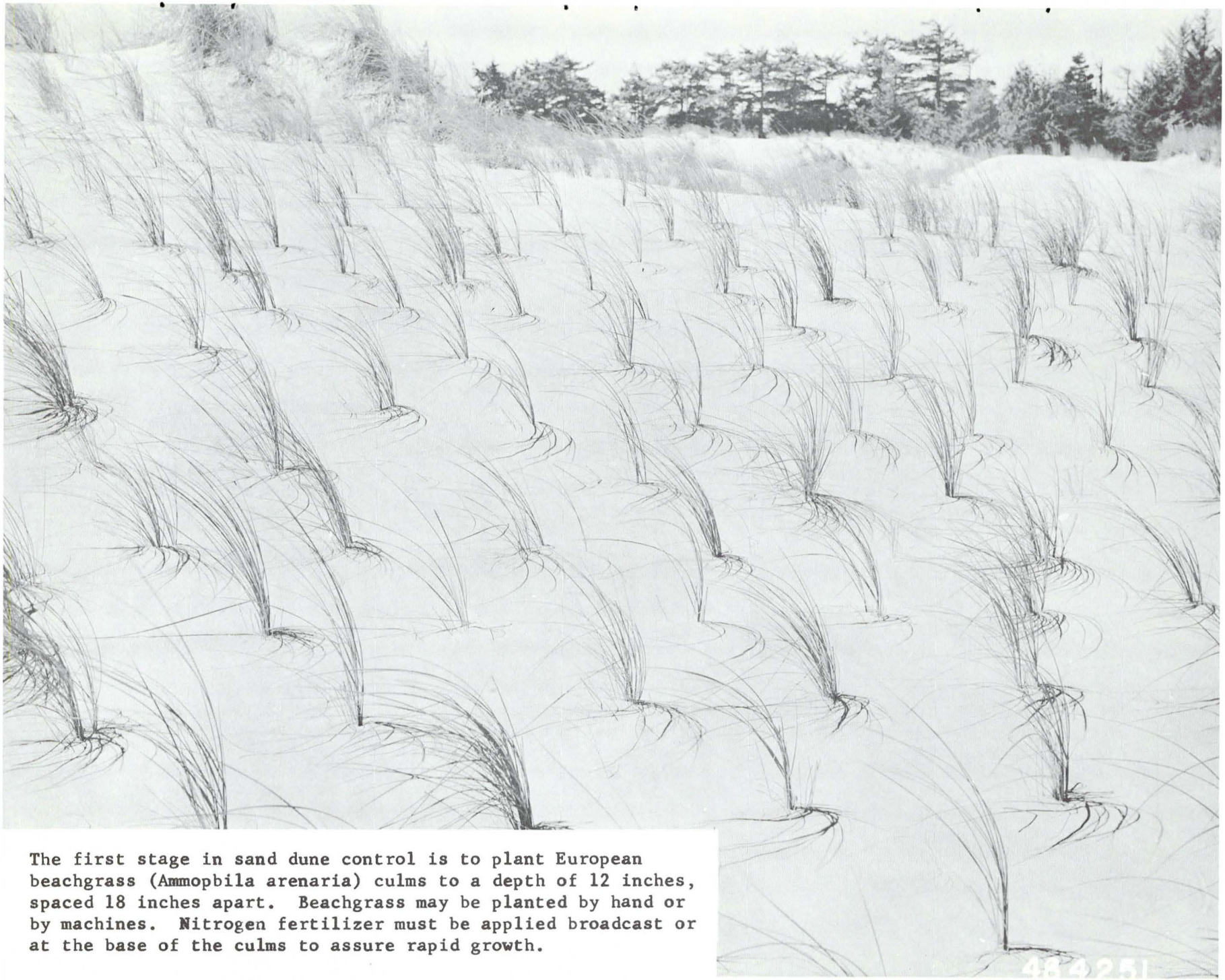
U. S. Department of Agriculture
Forest Service
Region 6

1959

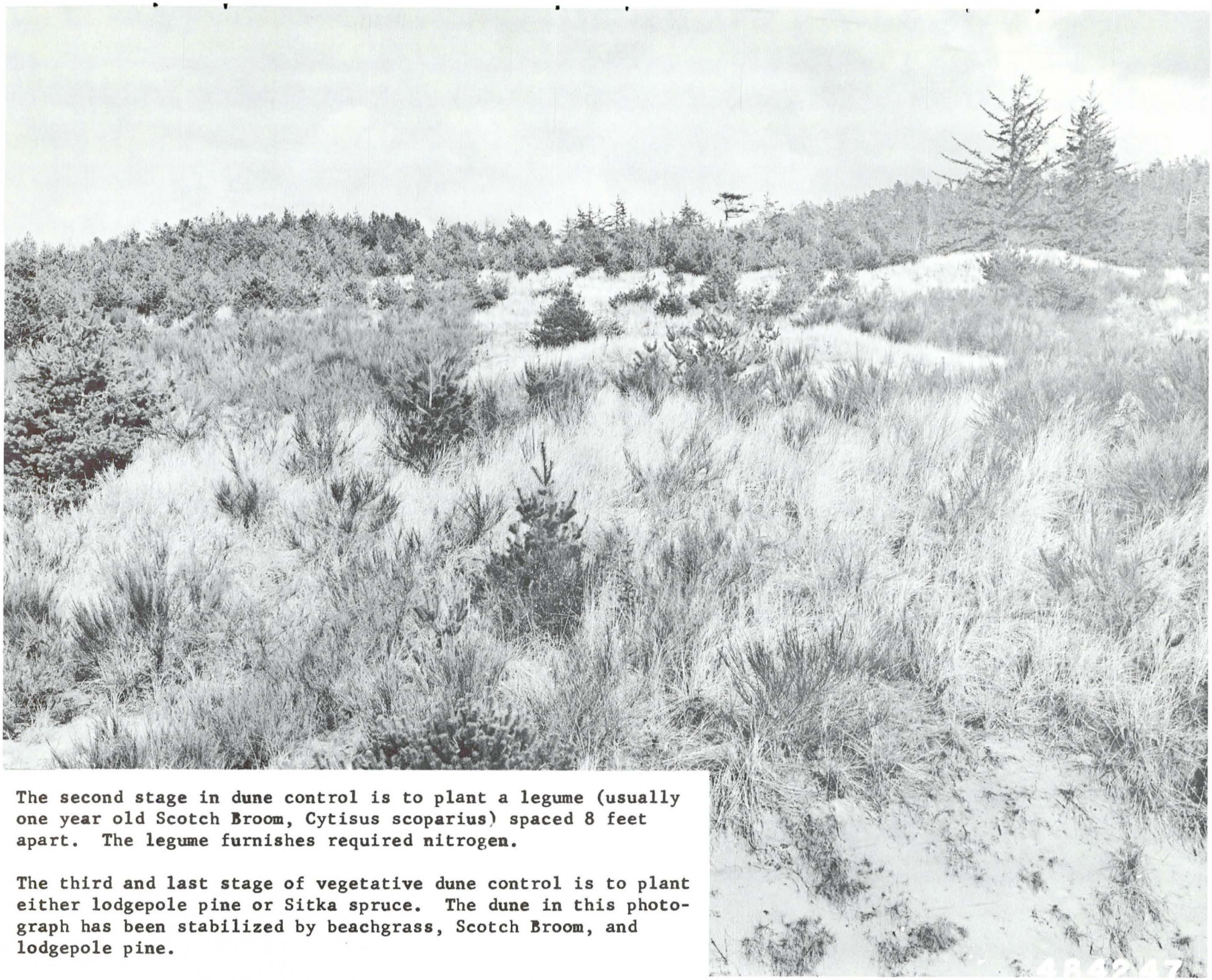


"There are only two kinds of landscape that are tolerable - one where man has never been; the other where he has achieved harmony." - Sir Francis Younghusband

Wildfire, unrestricted grazing, improperly located roads and trails, careless removal of timber, and land abuse in general resulted in these sand dunes in western Oregon.



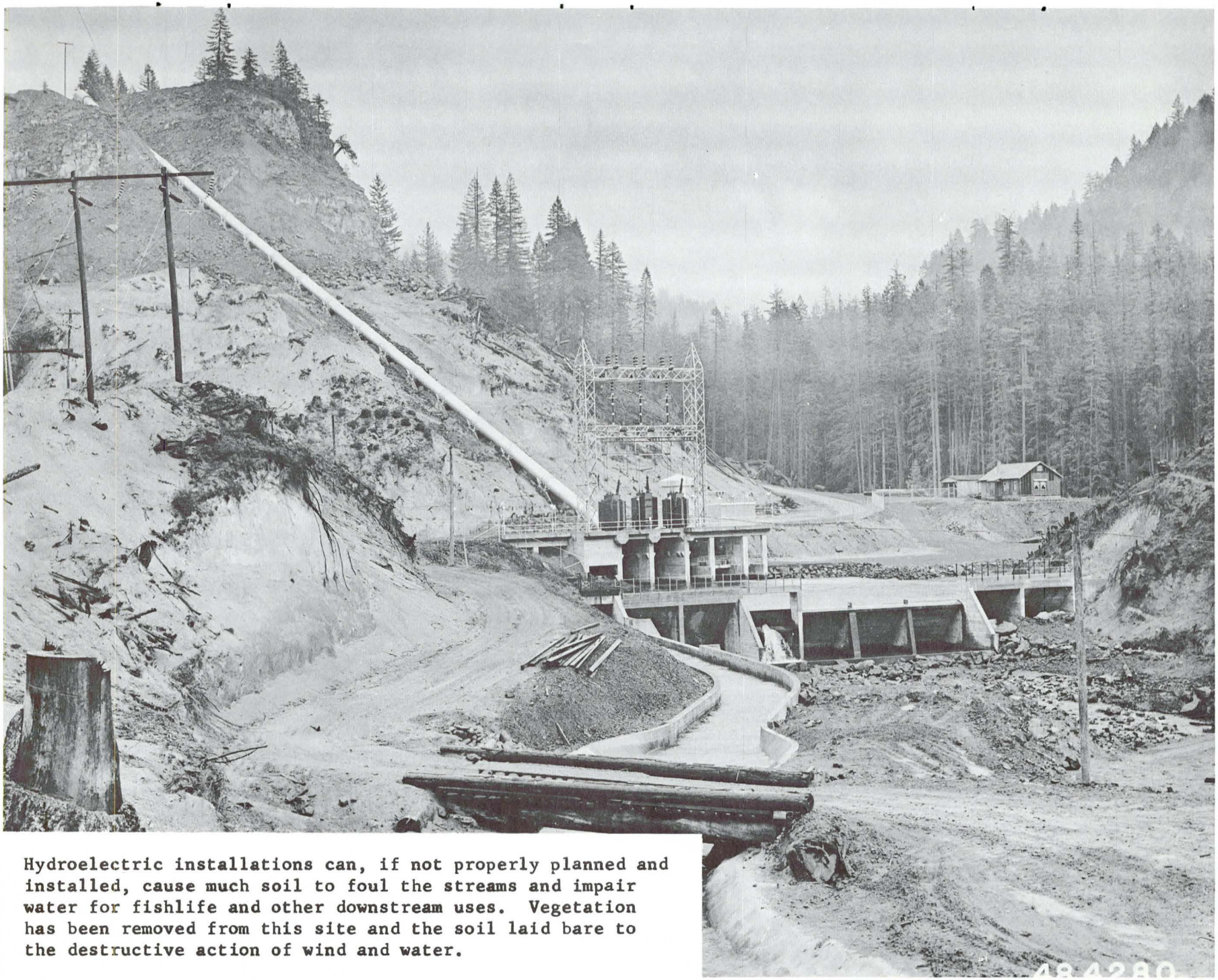
The first stage in sand dune control is to plant European beachgrass (Ammopbila arenaria) culms to a depth of 12 inches, spaced 18 inches apart. Beachgrass may be planted by hand or by machines. Nitrogen fertilizer must be applied broadcast or at the base of the culms to assure rapid growth.



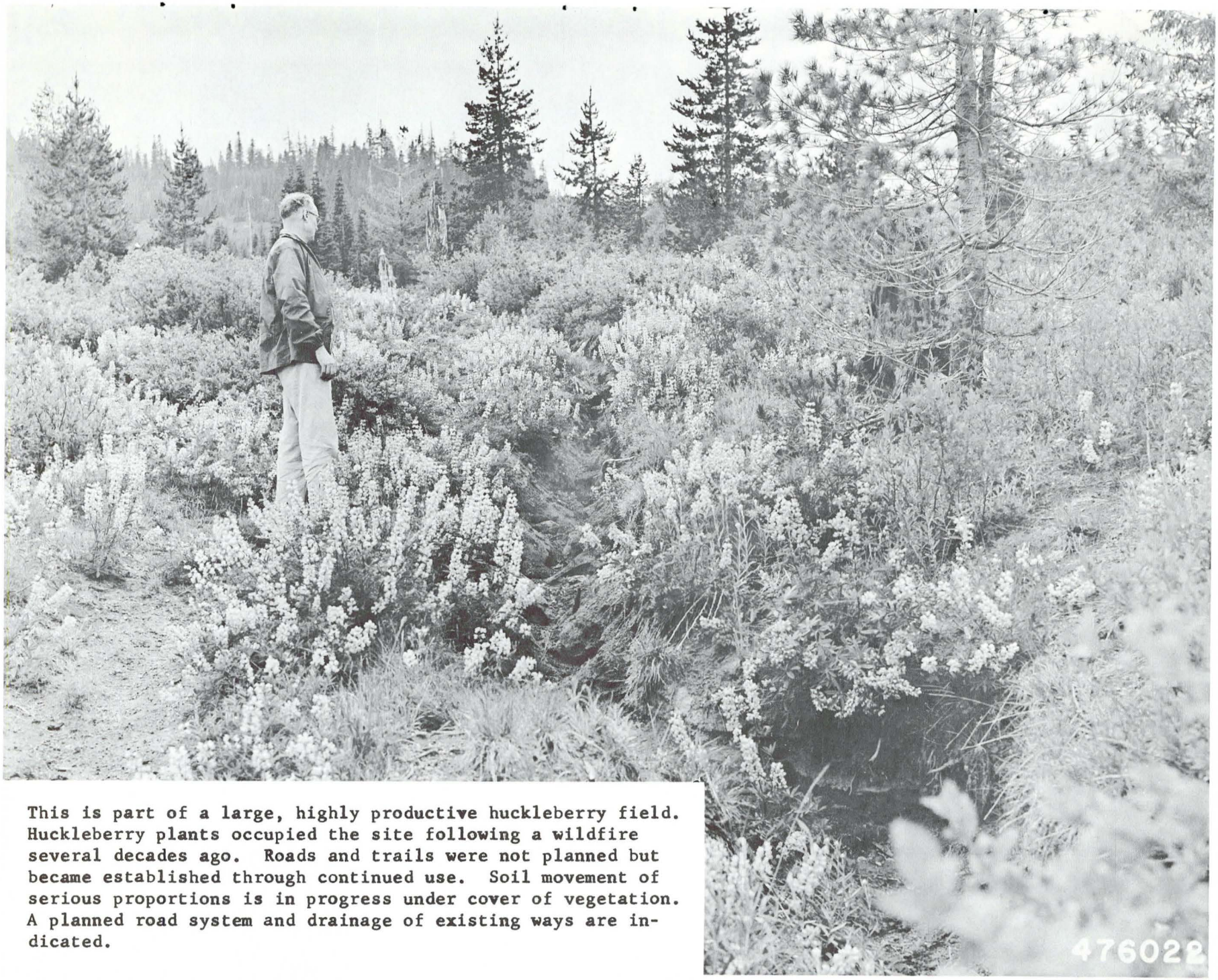
The second stage in dune control is to plant a legume (usually one year old Scotch Broom, Cytisus scoparius) spaced 8 feet apart. The legume furnishes required nitrogen.

The third and last stage of vegetative dune control is to plant either lodgepole pine or Sitka spruce. The dune in this photograph has been stabilized by beachgrass, Scotch Broom, and lodgepole pine.

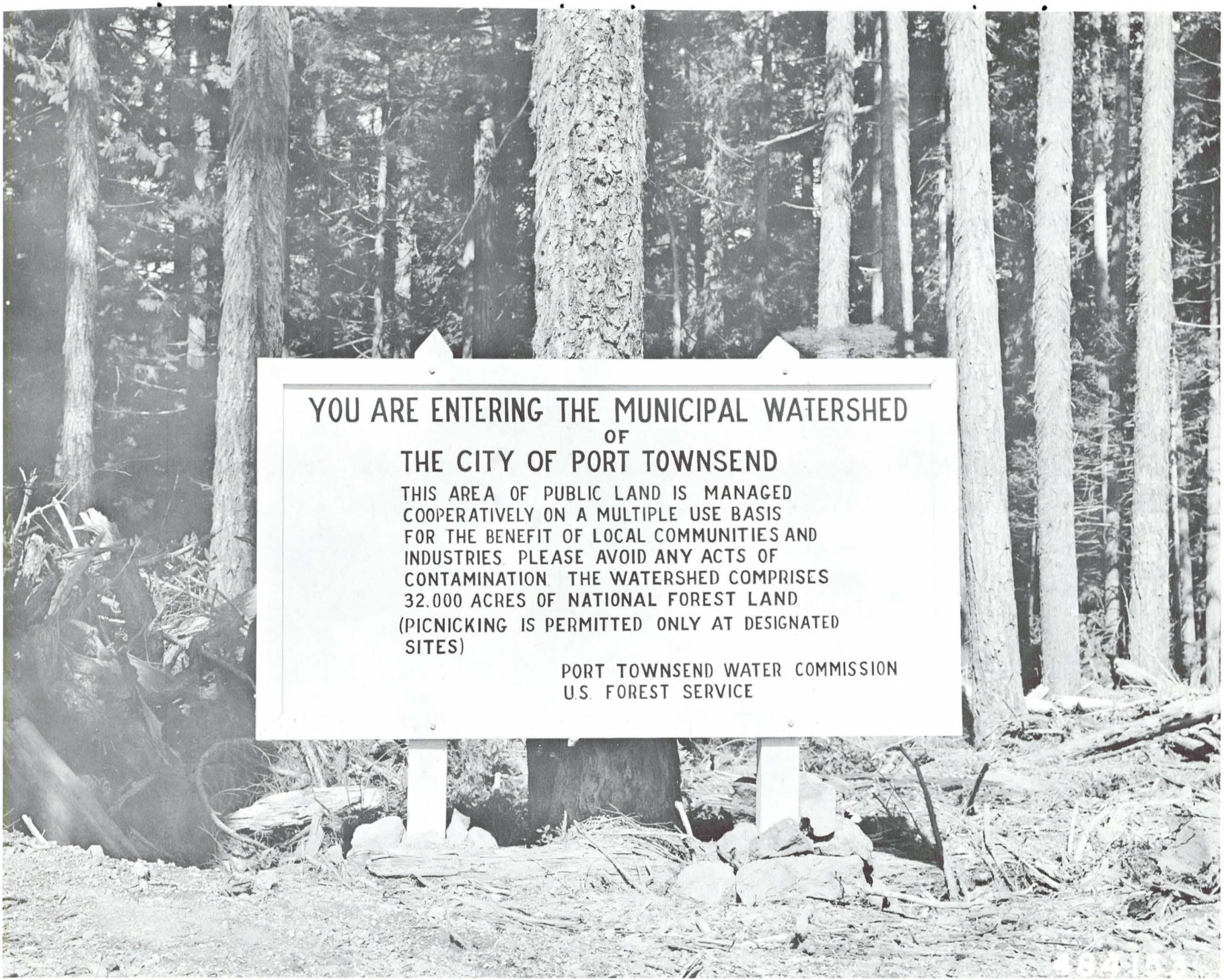
Oregon State Wizard Falls fish hatchery requires pure mountain water of proper temperature for maximum production of fish.

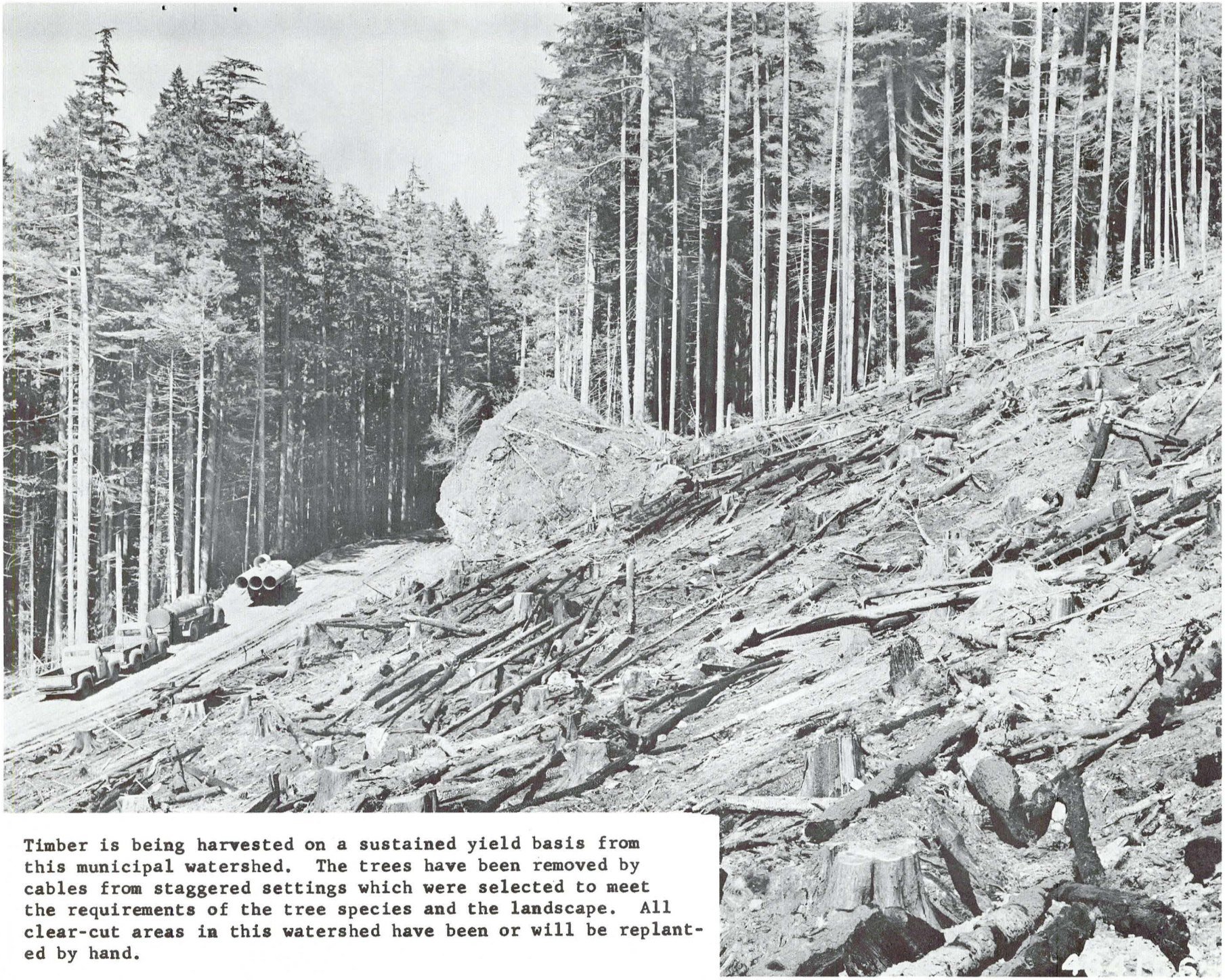


Hydroelectric installations can, if not properly planned and installed, cause much soil to foul the streams and impair water for fishlife and other downstream uses. Vegetation has been removed from this site and the soil laid bare to the destructive action of wind and water.

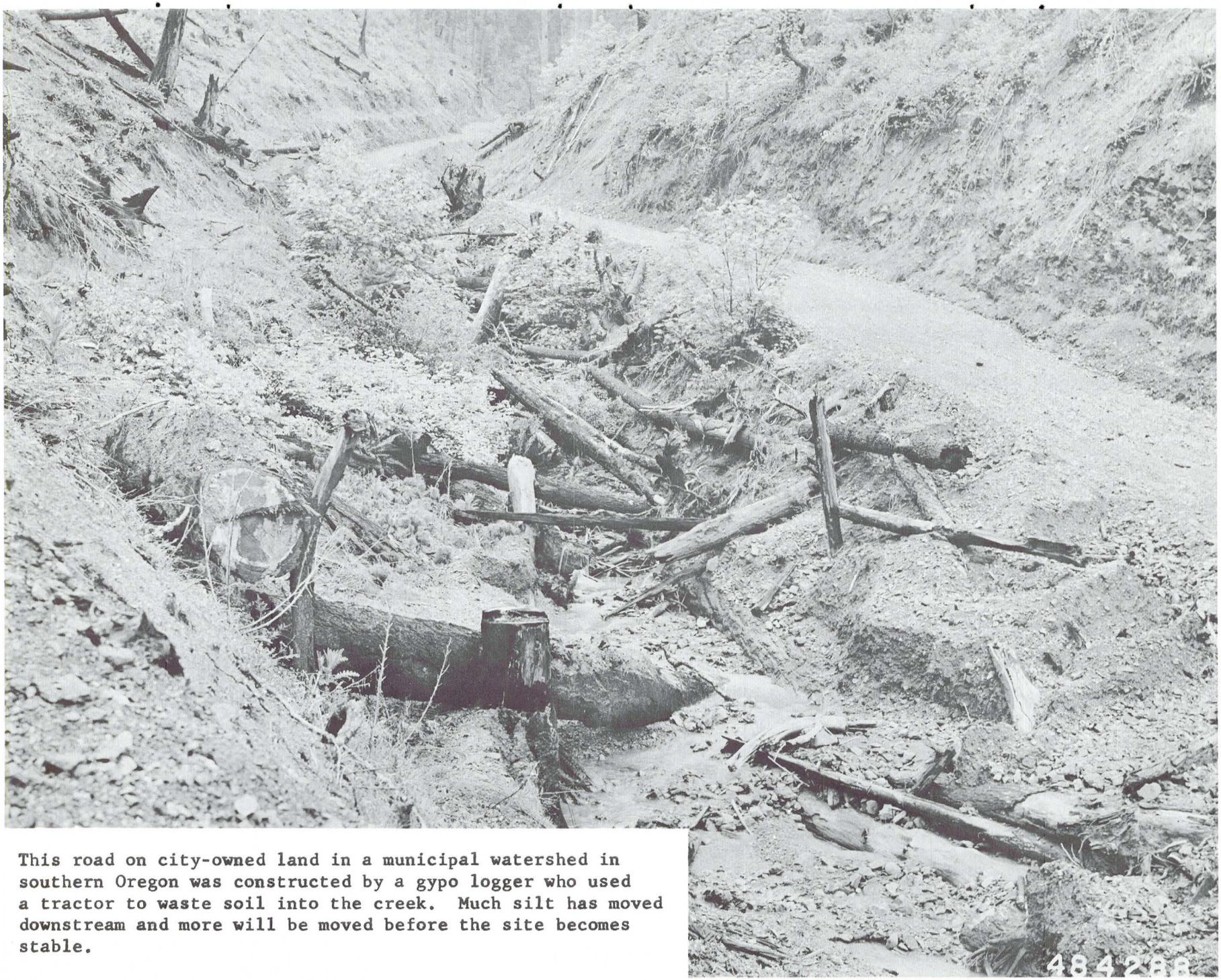


This is part of a large, highly productive huckleberry field. Huckleberry plants occupied the site following a wildfire several decades ago. Roads and trails were not planned but became established through continued use. Soil movement of serious proportions is in progress under cover of vegetation. A planned road system and drainage of existing ways are indicated.

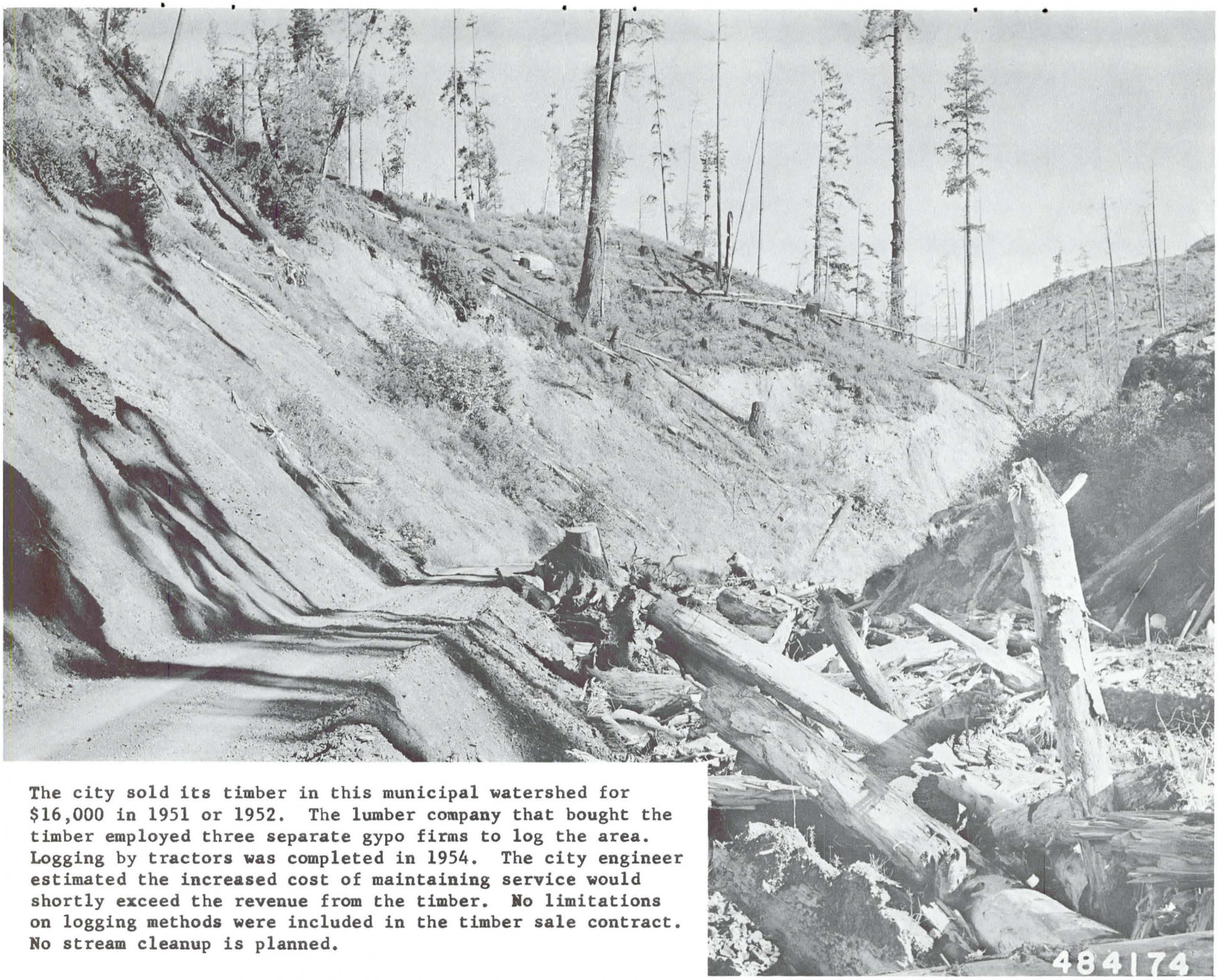

YOU ARE ENTERING THE MUNICIPAL WATERSHED
OF
THE CITY OF PORT TOWNSEND
THIS AREA OF PUBLIC LAND IS MANAGED COOPERATIVELY ON A MULTIPLE USE BASIS FOR THE BENEFIT OF LOCAL COMMUNITIES AND INDUSTRIES. PLEASE AVOID ANY ACTS OF CONTAMINATION. THE WATERSHED COMPRISES 32,000 ACRES OF NATIONAL FOREST LAND
(PICNICKING IS PERMITTED ONLY AT DESIGNATED SITES)
PORT TOWNSEND WATER COMMISSION
U.S. FOREST SERVICE



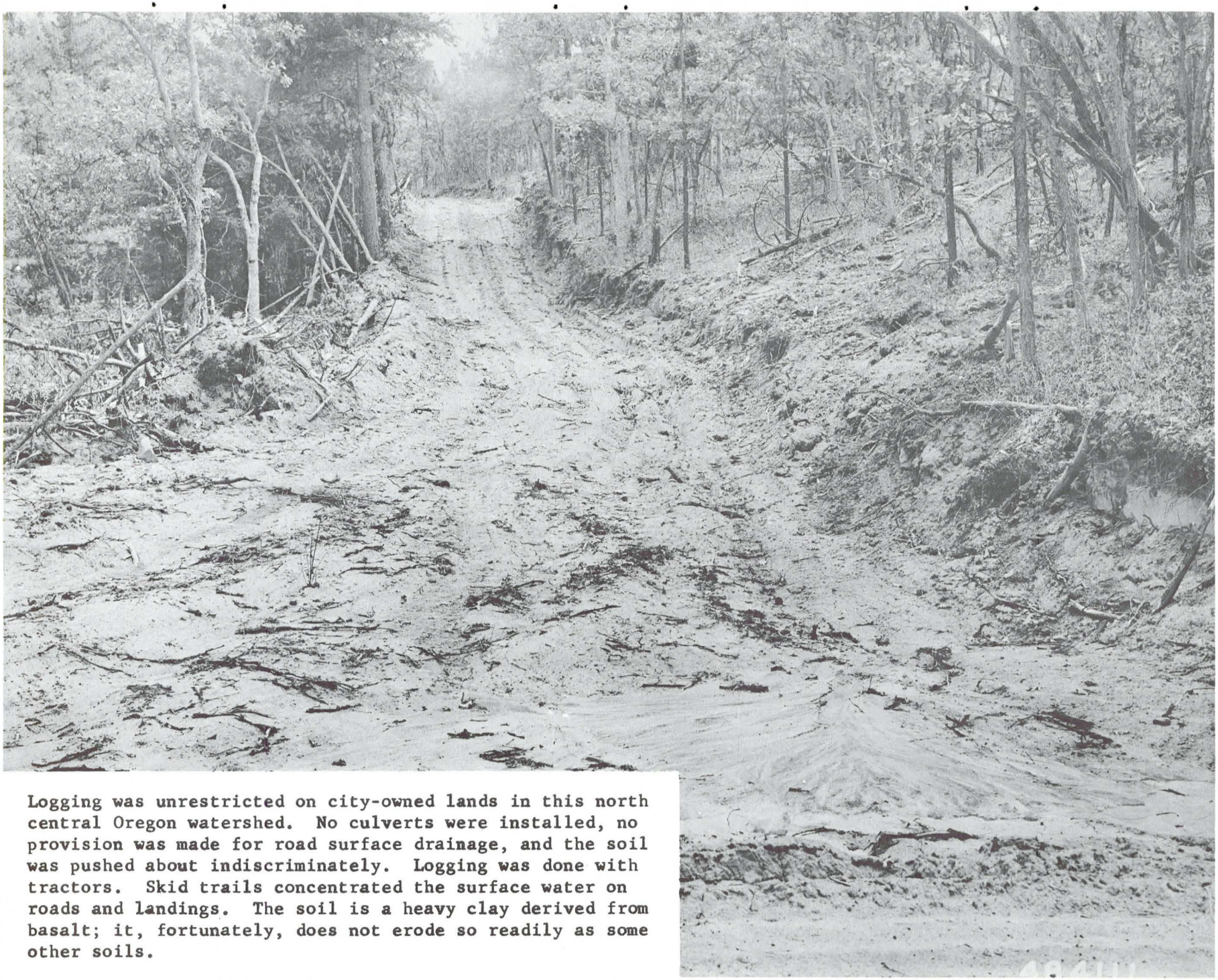
Timber is being harvested on a sustained yield basis from this municipal watershed. The trees have been removed by cables from staggered settings which were selected to meet the requirements of the tree species and the landscape. All clear-cut areas in this watershed have been or will be replanted by hand.



This road on city-owned land in a municipal watershed in southern Oregon was constructed by a gypo logger who used a tractor to waste soil into the creek. Much silt has moved downstream and more will be moved before the site becomes stable.

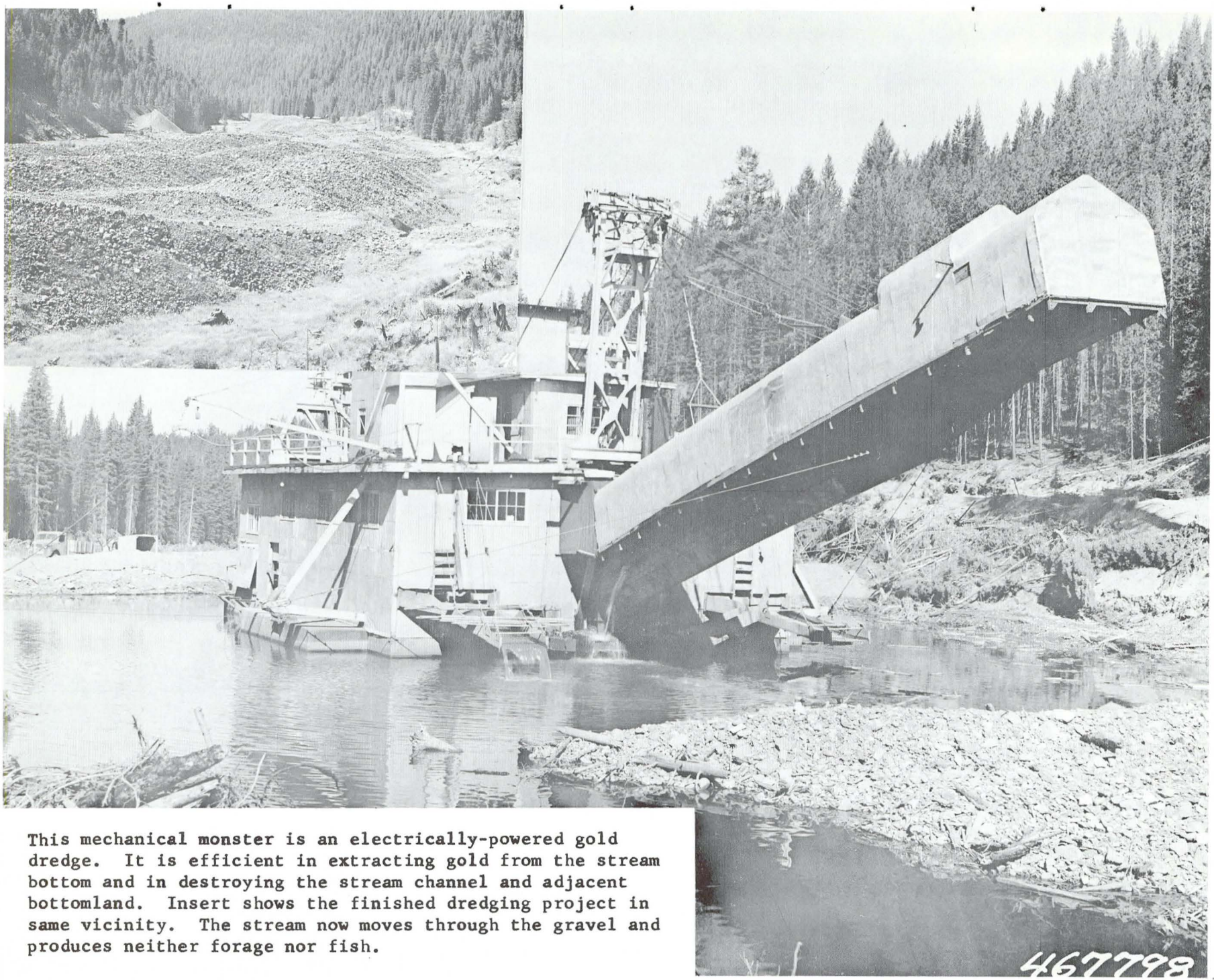


The city sold its timber in this municipal watershed for $16,000 in 1951 or 1952. The lumber company that bought the timber employed three separate gypo firms to log the area. Logging by tractors was completed in 1954. The city engineer estimated the increased cost of maintaining service would shortly exceed the revenue from the timber. No limitations on logging methods were included in the timber sale contract. No stream cleanup is planned.

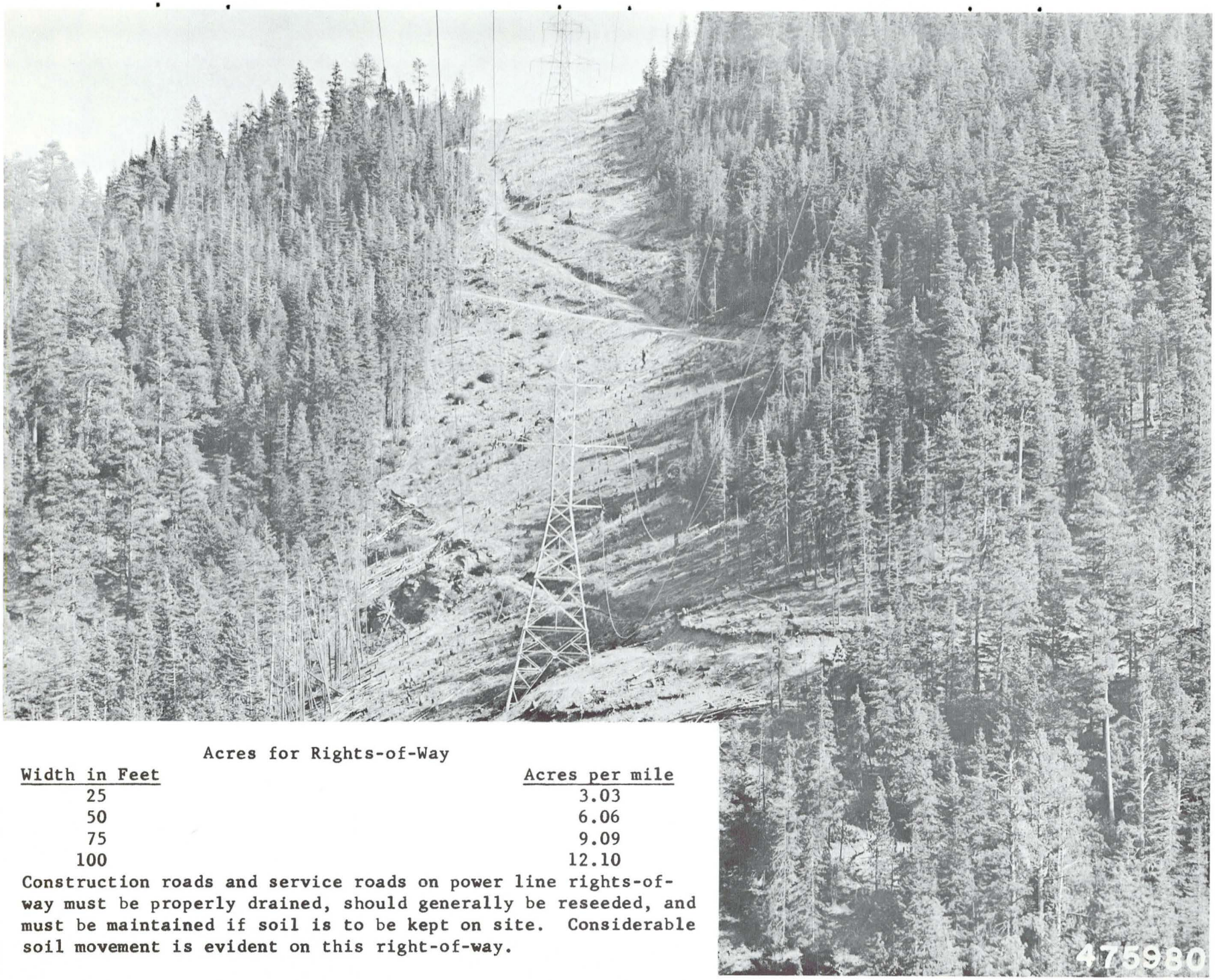


Logging was unrestricted on city-owned lands in this north central Oregon watershed. No culverts were installed, no provision was made for road surface drainage, and the soil was pushed about indiscriminately. Logging was done with tractors. Skid trails concentrated the surface water on roads and landings. The soil is a heavy clay derived from basalt; it, fortunately, does not erode so readily as some other soils.

View of creek bottom on city-owned land in same watershed as shown on preceding page. No attempt was made by contract logger to keep logging debris out of stream or to remove it. The logging debris obstructs passage of fish and impairs the quality of municipal water.



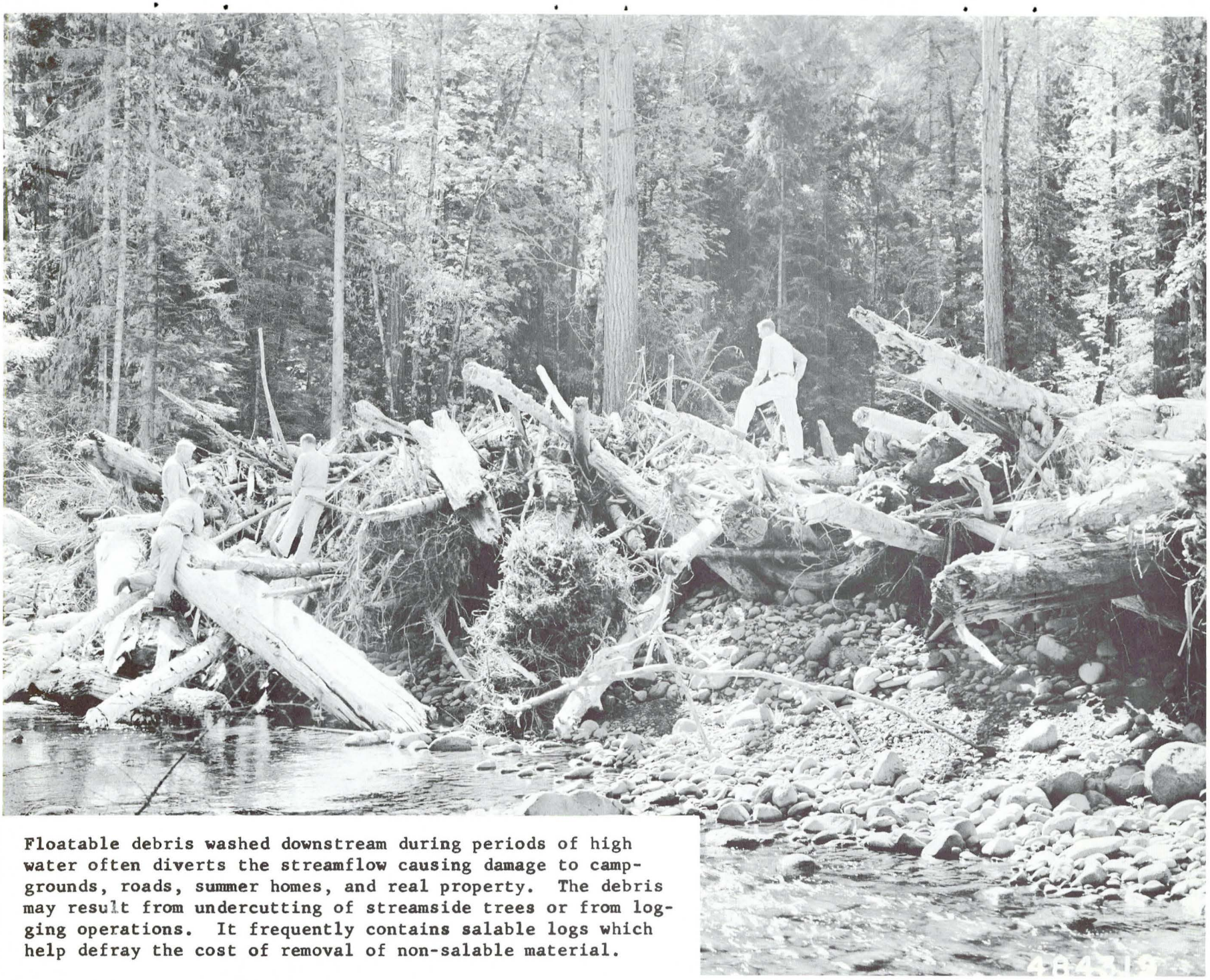
This mechanical monster is an electrically-powered gold dredge. It is efficient in extracting gold from the stream bottom and in destroying the stream channel and adjacent bottomland. Insert shows the finished dredging project in same vicinity. The stream now moves through the gravel and produces neither forage nor fish.



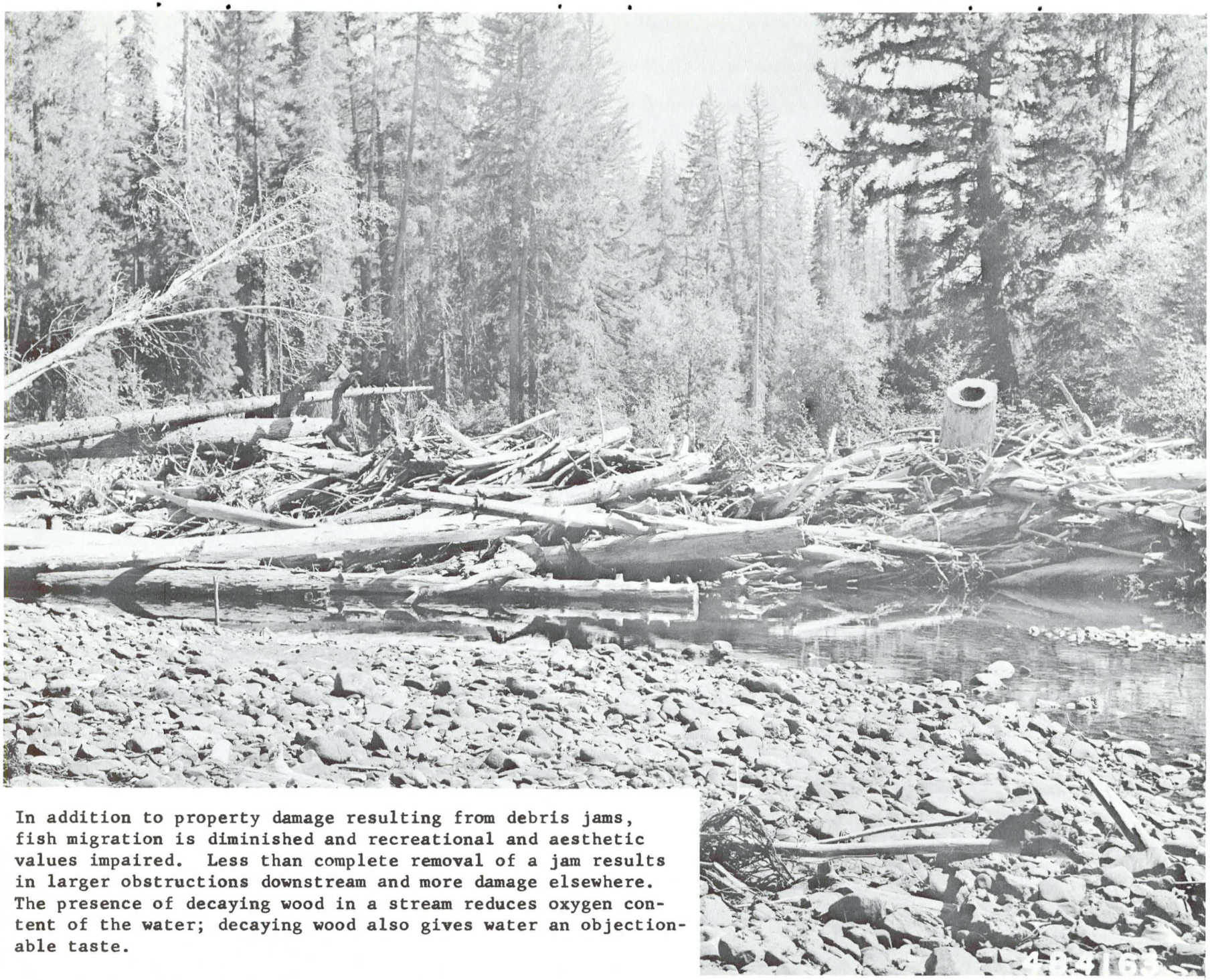
Acres for Rights-of-Way

Width in Feet	Acres per mile
25	3.03
50	6.06
75	9.09
100	12.10

Construction roads and service roads on power line rights-of-way must be properly drained, should generally be reseeded, and must be maintained if soil is to be kept on site. Considerable soil movement is evident on this right-of-way.



Floatable debris washed downstream during periods of high water often diverts the streamflow causing damage to campgrounds, roads, summer homes, and real property. The debris may result from undercutting of streamside trees or from logging operations. It frequently contains salable logs which help defray the cost of removal of non-salable material.

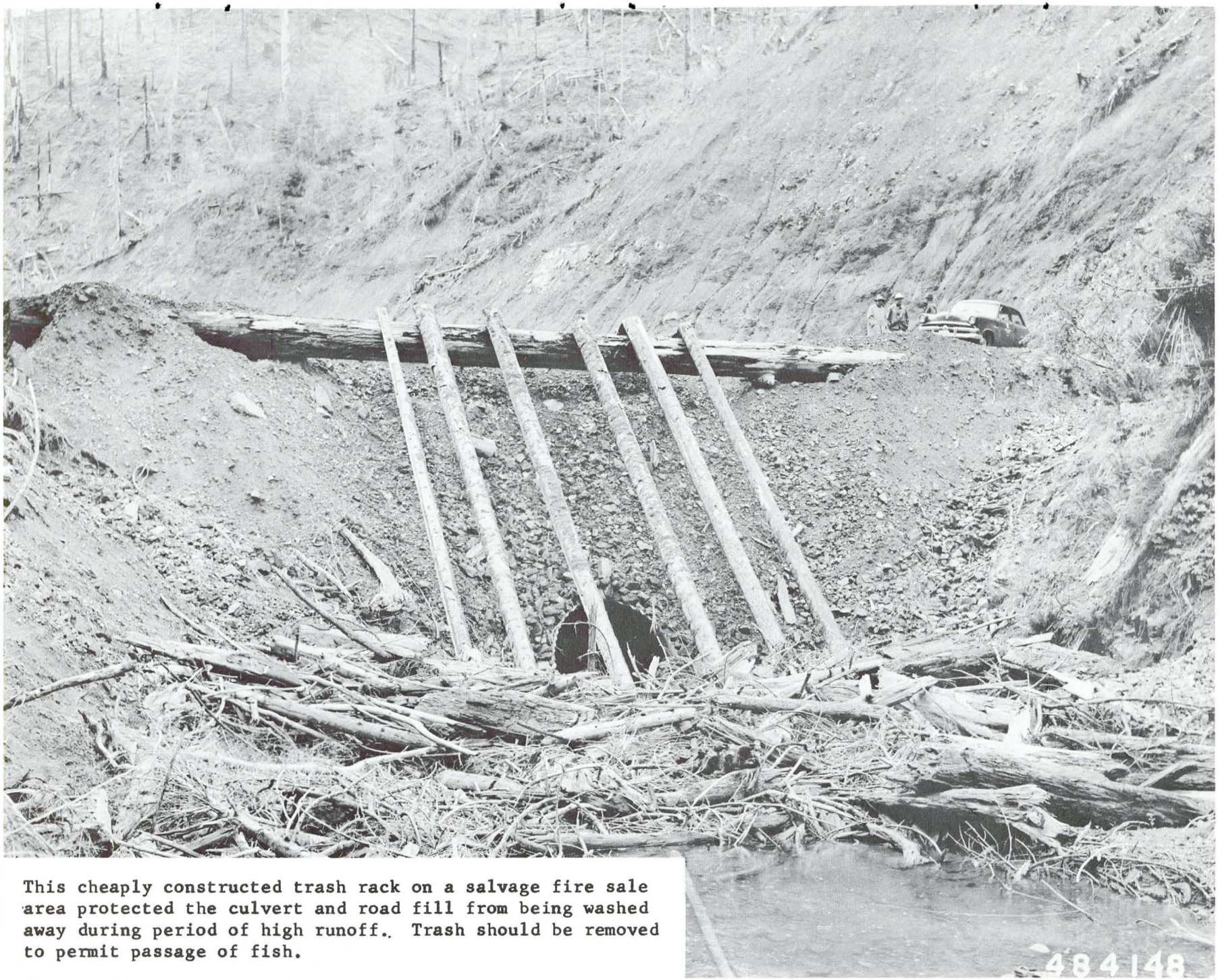


In addition to property damage resulting from debris jams, fish migration is diminished and recreational and aesthetic values impaired. Less than complete removal of a jam results in larger obstructions downstream and more damage elsewhere. The presence of decaying wood in a stream reduces oxygen content of the water; decaying wood also gives water an objectionable taste.

Staffman McComb and Supervisor Aufderheide discussing plans for removal of debris jam which was formed during period of high-water flow.

A tractor was used to clear live vegetation and debris from this stream which was adjacent to a well drilling camp. Ordinarily tractors must be kept out of stream channels at all times if we are to have stable streambanks and clear, cool water.

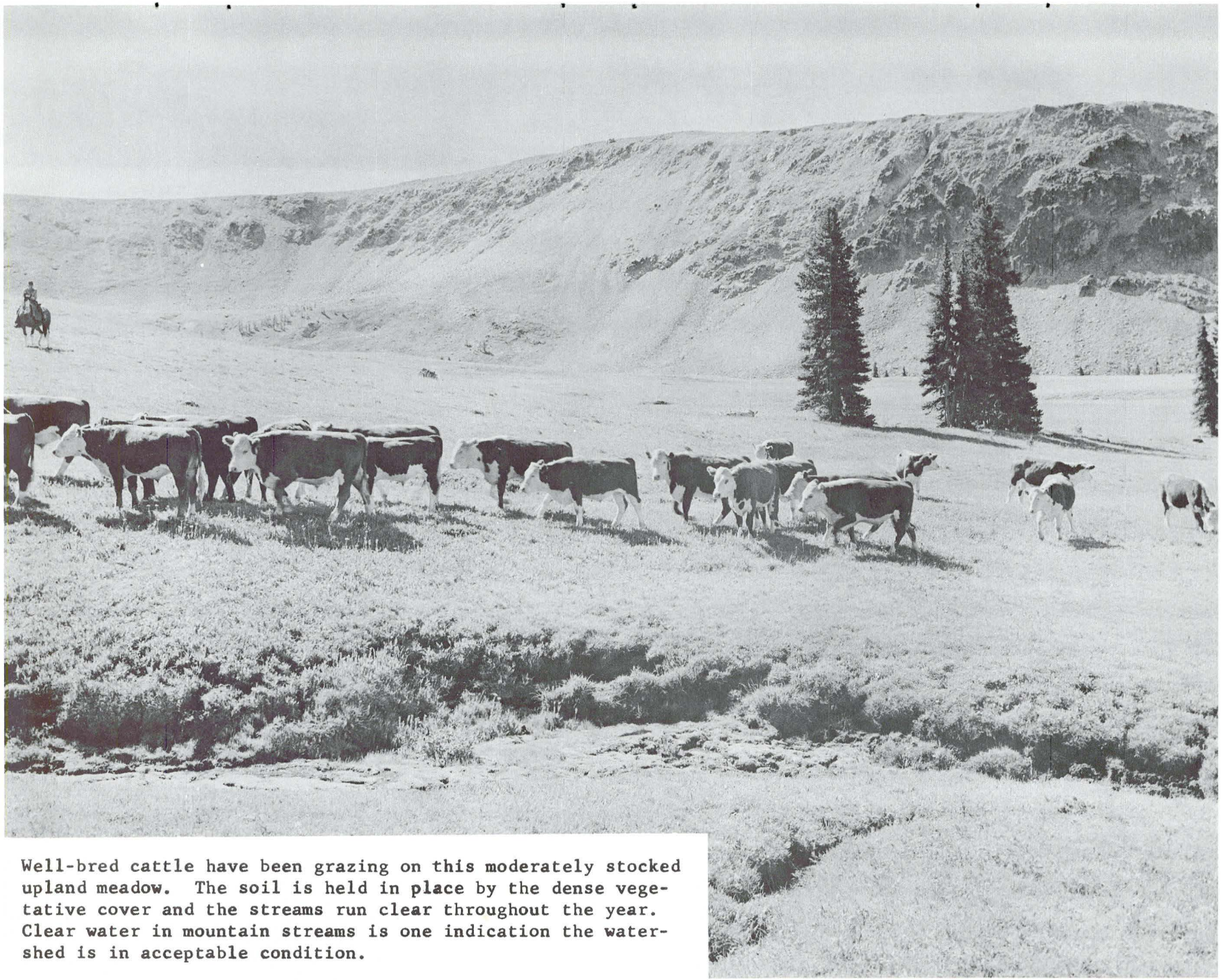
A trash rack made by a logger using local materials was effective in keeping logging debris from the road culvert. Debris has been removed from upper side of rack.



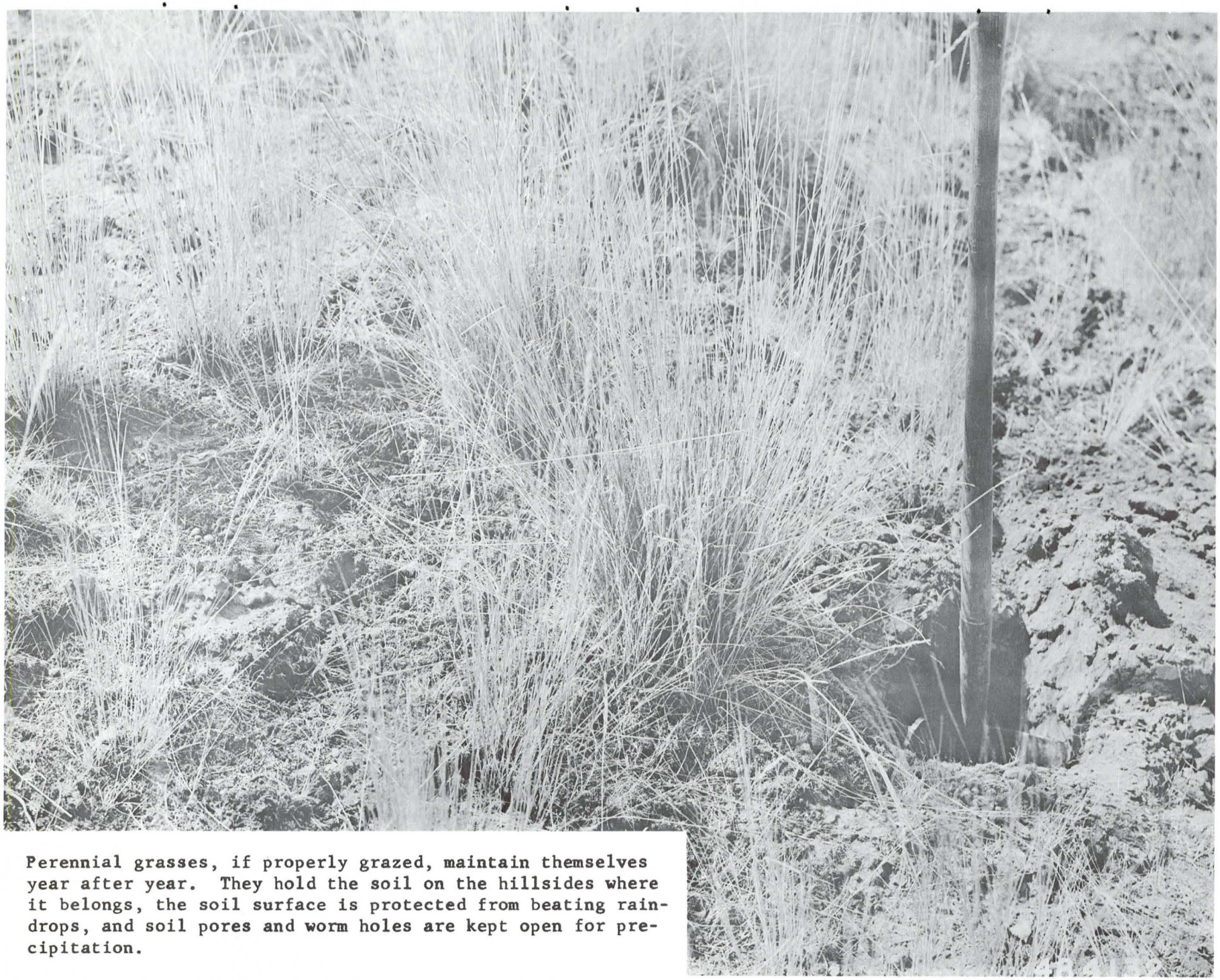
This cheaply constructed trash rack on a salvage fire sale area protected the culvert and road fill from being washed away during period of high runoff.. Trash should be removed to permit passage of fish.

This trash rack made of steel rails and concrete cost about $1,000.

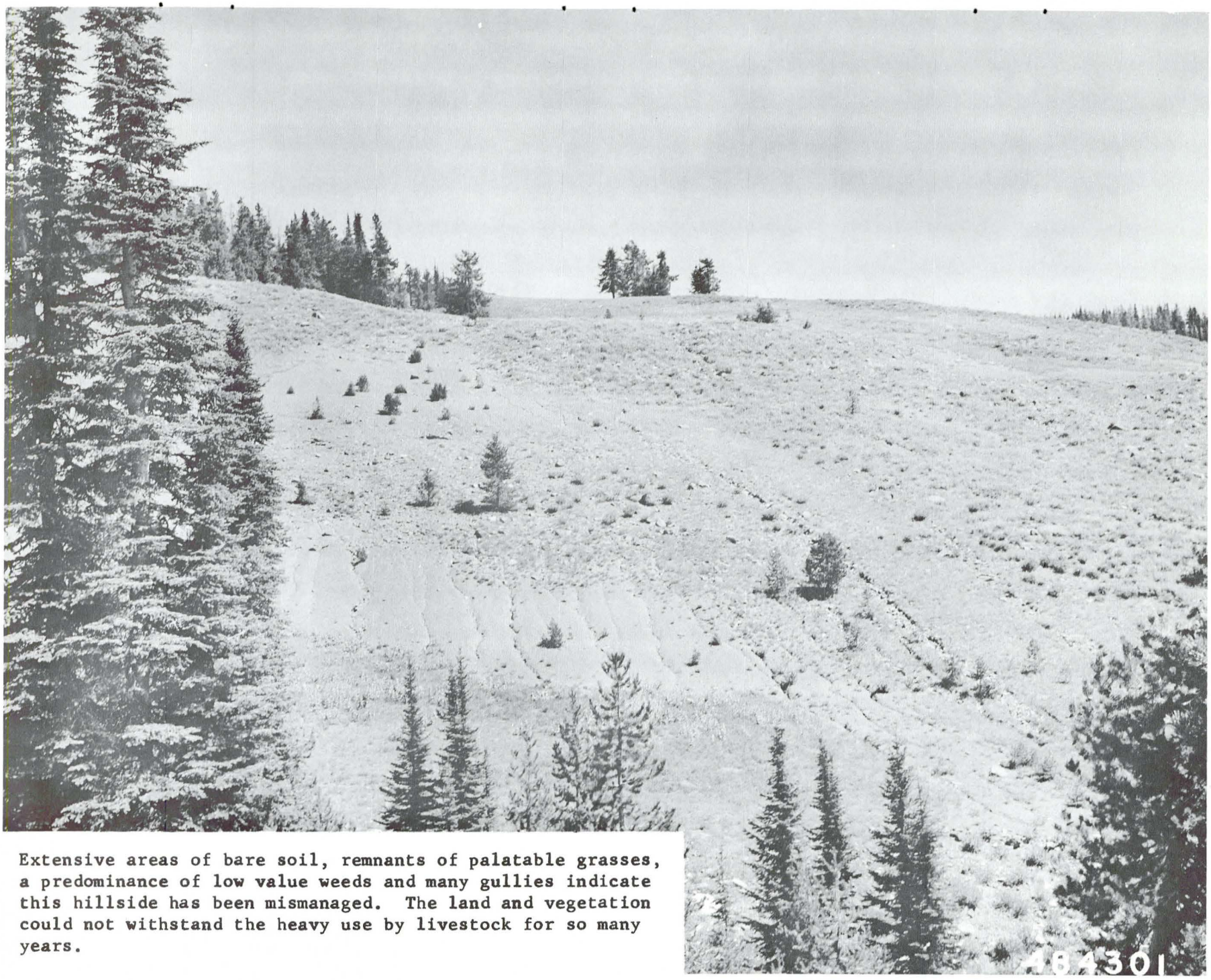
This trash rack failed during a period of moderately high-water flow. It was inadequate to hold the trash which drifted from an unlogged watershed.



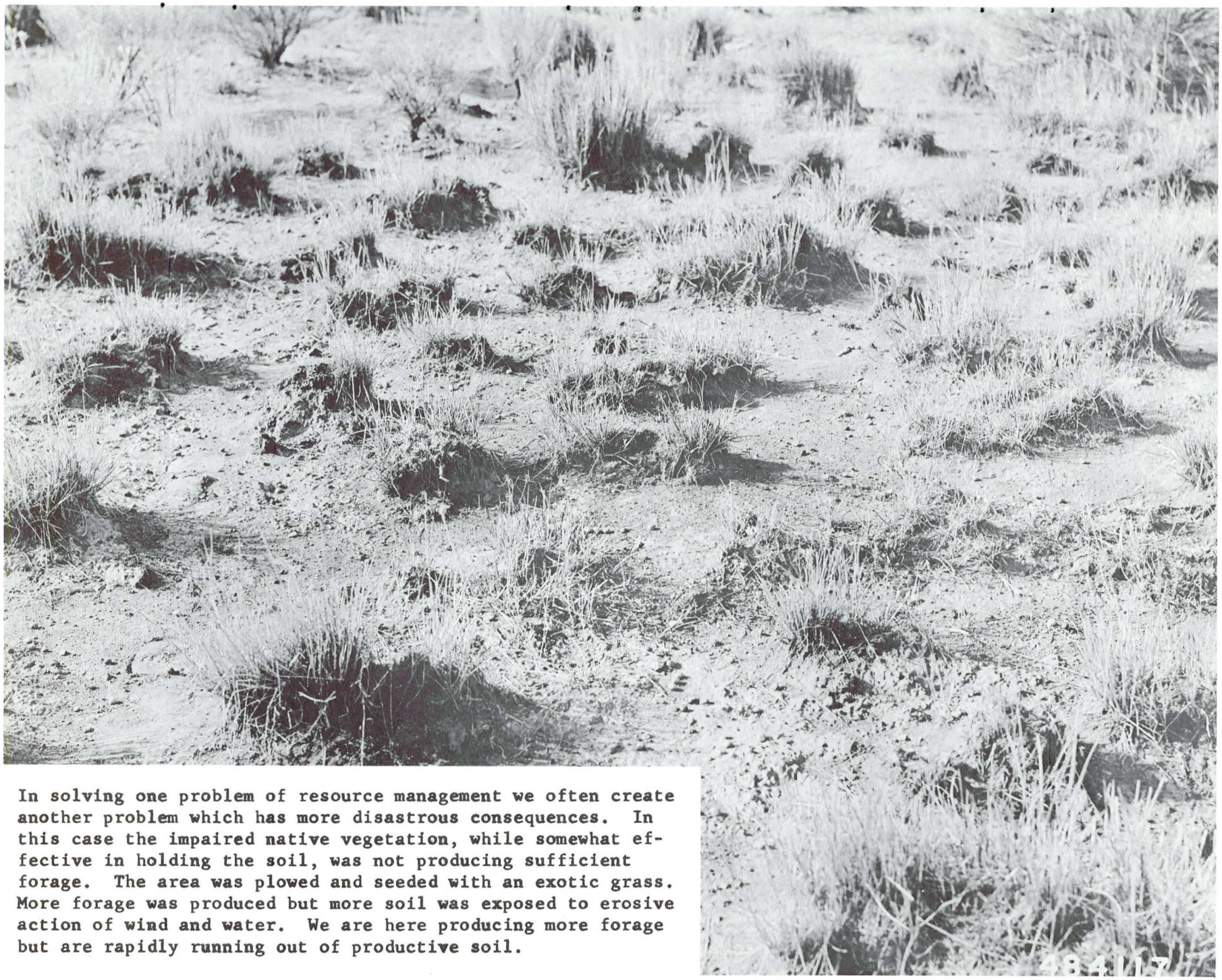
Well-bred cattle have been grazing on this moderately stocked upland meadow. The soil is held in place by the dense vegetative cover and the streams run clear throughout the year. Clear water in mountain streams is one indication the watershed is in acceptable condition.



Perennial grasses, if properly grazed, maintain themselves year after year. They hold the soil on the hillsides where it belongs, the soil surface is protected from beating raindrops, and soil pores and worm holes are kept open for precipitation.



Extensive areas of bare soil, remnants of palatable grasses, a predominance of low value weeds and many gullies indicate this hillside has been mismanaged. The land and vegetation could not withstand the heavy use by livestock for so many years.

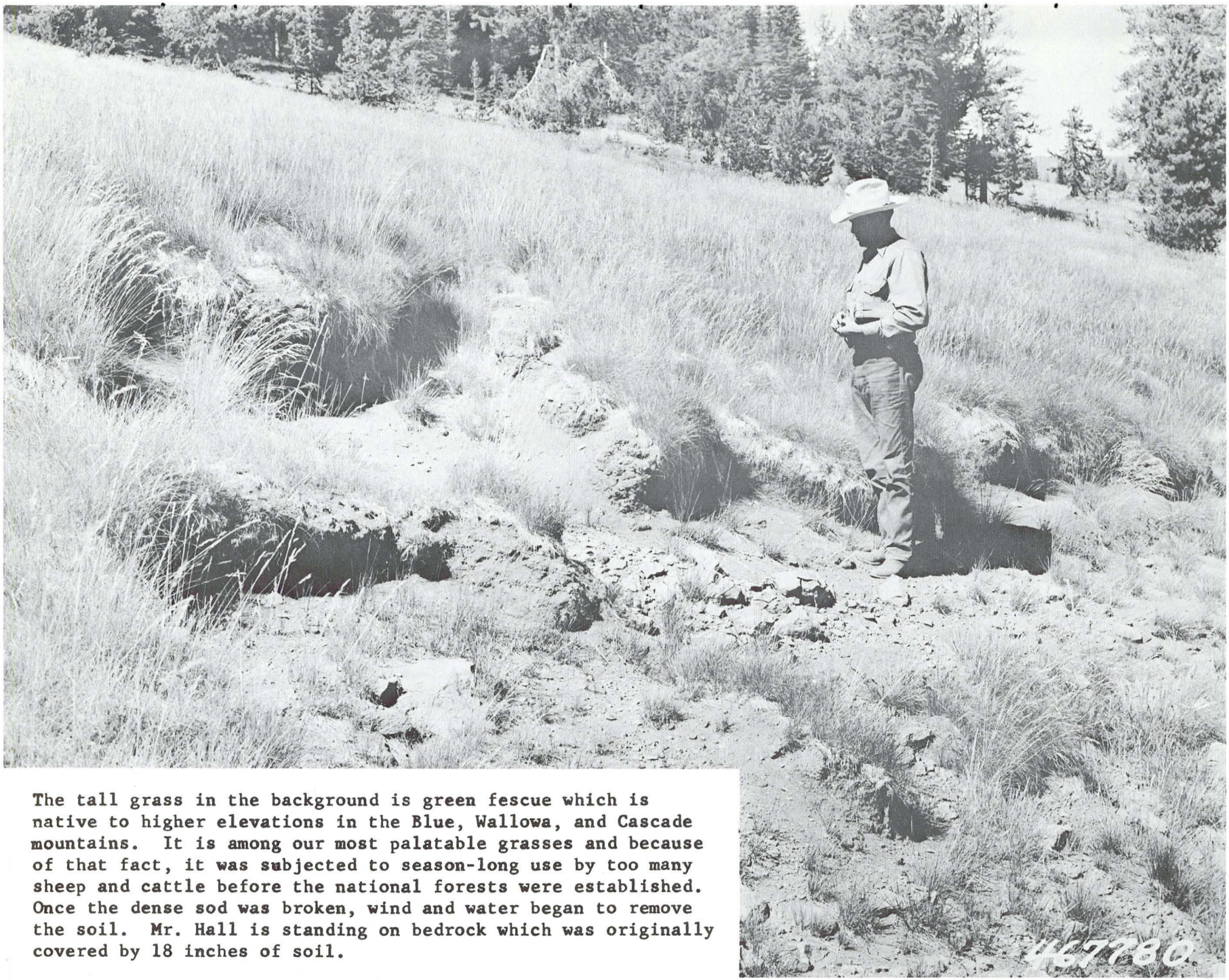


In solving one problem of resource management we often create another problem which has more disastrous consequences. In this case the impaired native vegetation, while somewhat effective in holding the soil, was not producing sufficient forage. The area was plowed and seeded with an exotic grass. More forage was produced but more soil was exposed to erosive action of wind and water. We are here producing more forage but are rapidly running out of productive soil.

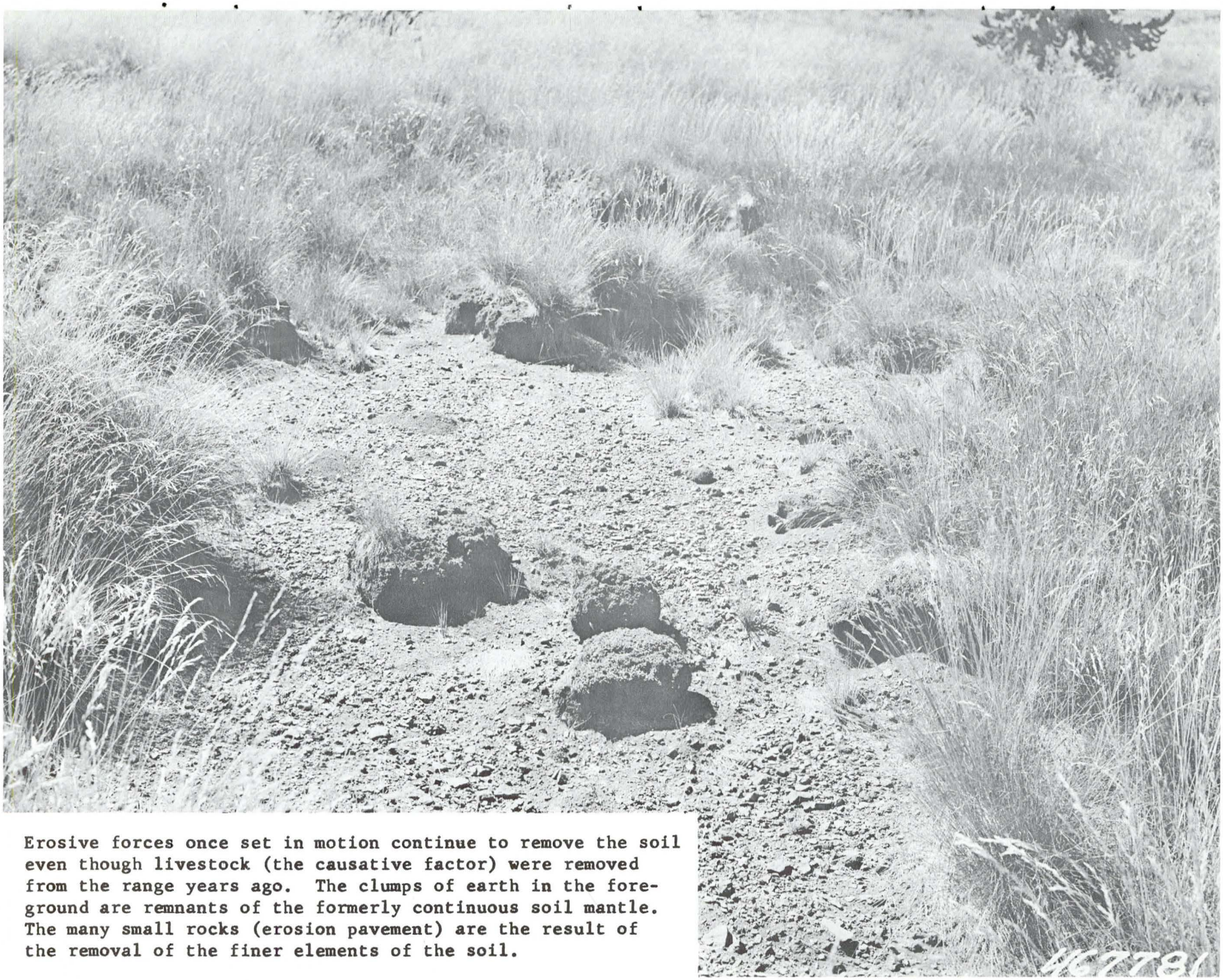
SD11/A5A45/213

Markstrom, Donald C. and Vern P. Yerkes. SPECIFIC GRAVITY VARIATION WITH HEIGHT IN BLACK HILLS PONDEROSA PINE. U.S.D.A. For. Serv. Res. Note RM-213. 4 p. 1972.

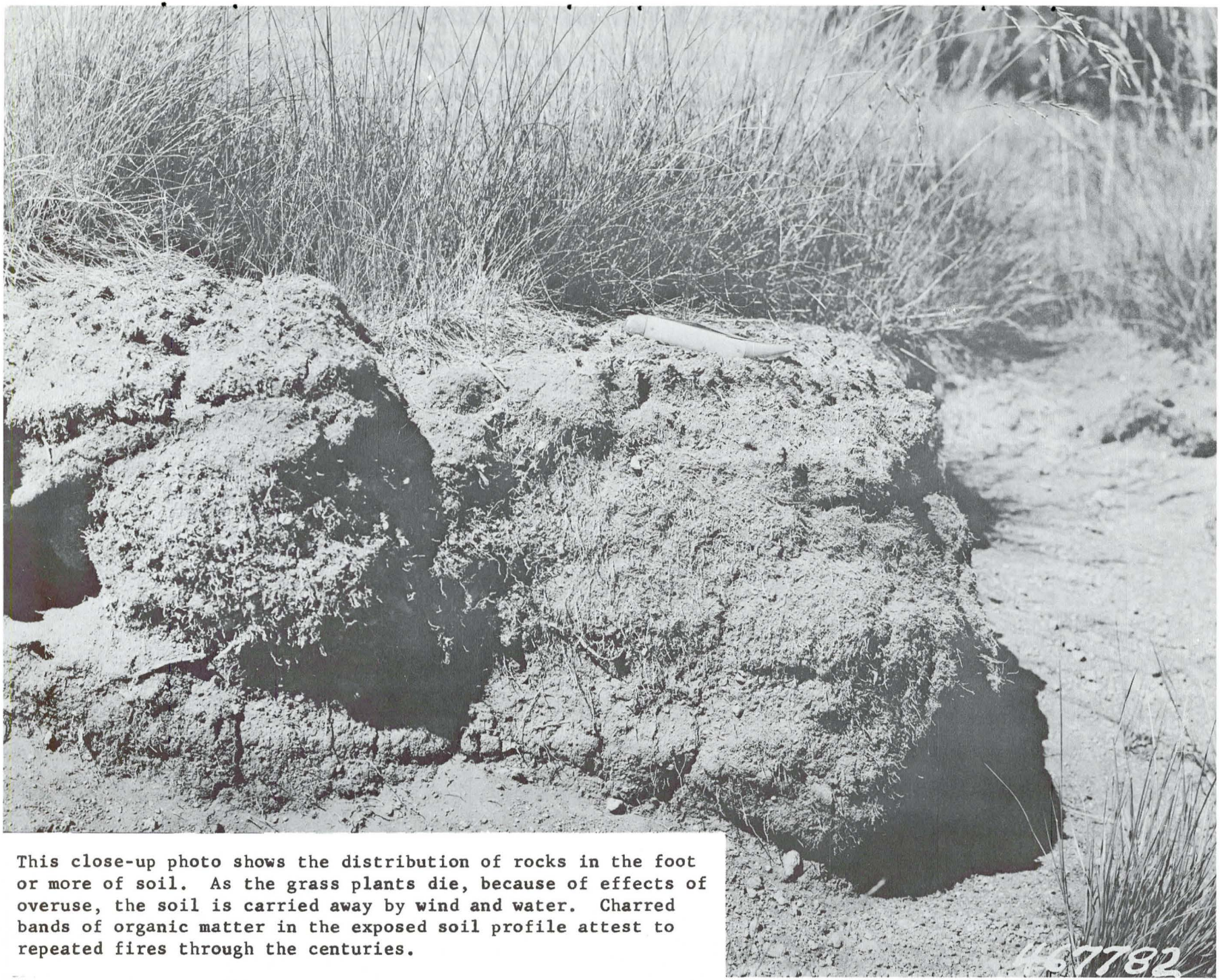
AUG 10 1972



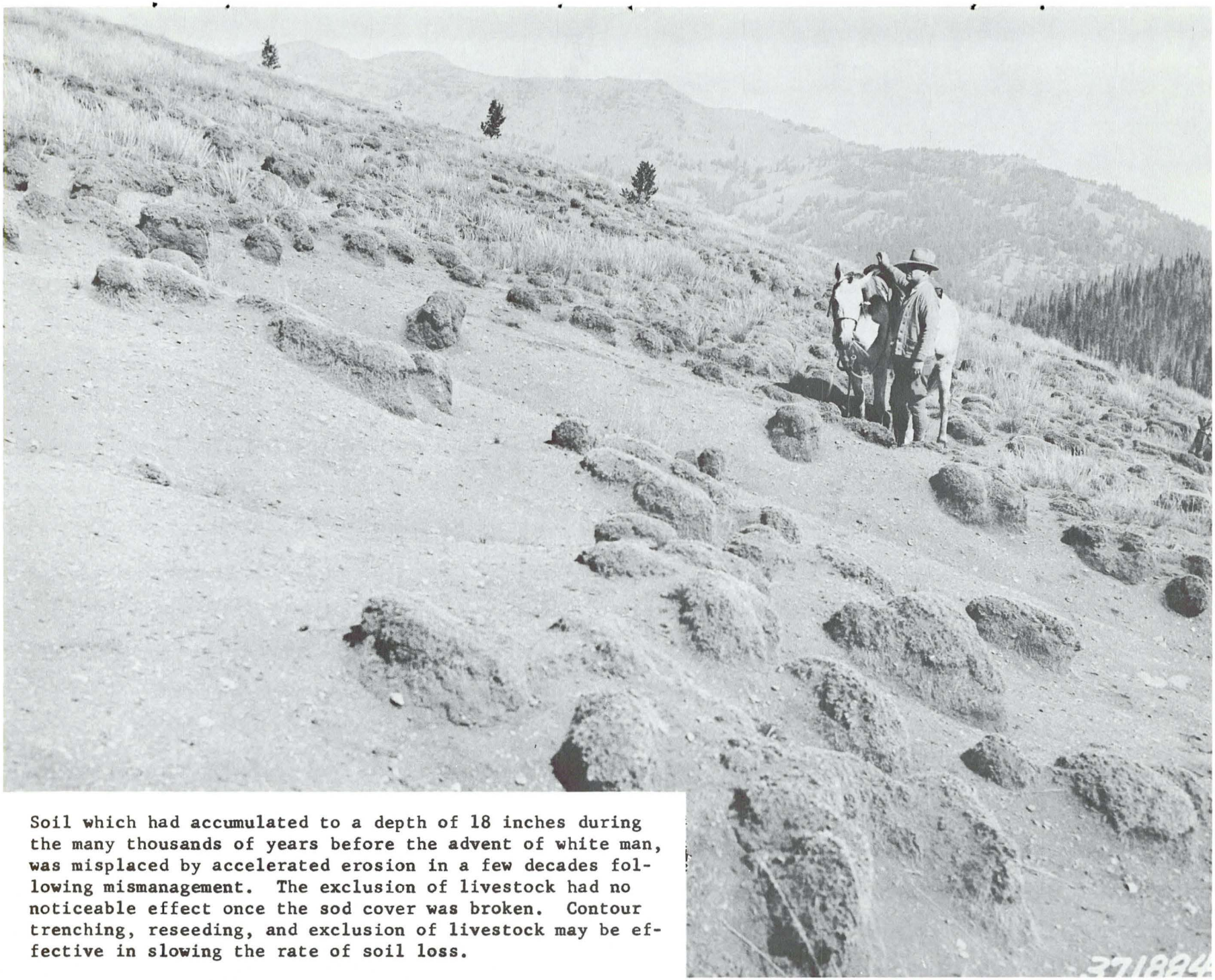
The tall grass in the background is green fescue which is native to higher elevations in the Blue, Wallowa, and Cascade mountains. It is among our most palatable grasses and because of that fact, it was subjected to season-long use by too many sheep and cattle before the national forests were established. Once the dense sod was broken, wind and water began to remove the soil. Mr. Hall is standing on bedrock which was originally covered by 18 inches of soil.



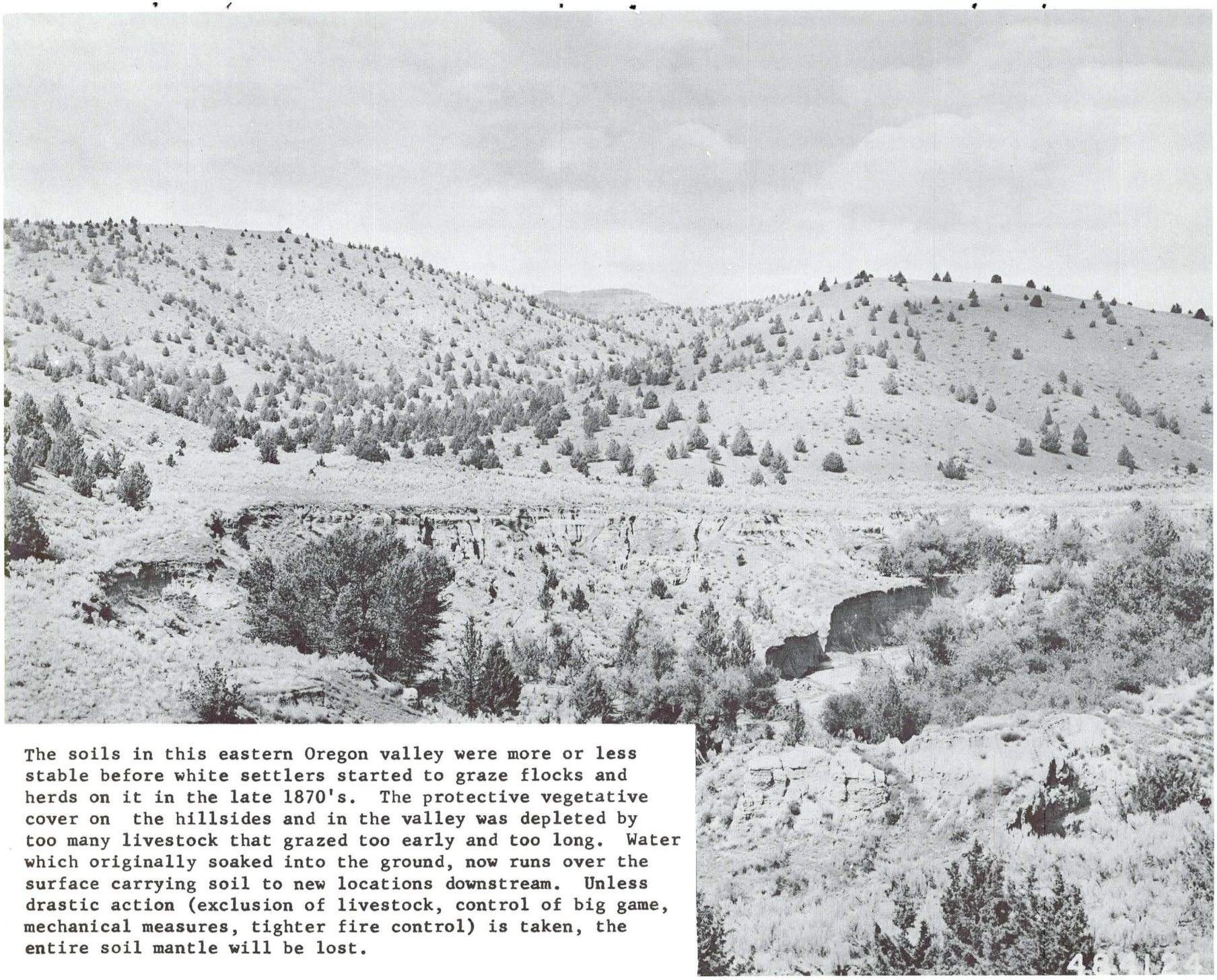
Erosive forces once set in motion continue to remove the soil even though livestock (the causative factor) were removed from the range years ago. The clumps of earth in the foreground are remnants of the formerly continuous soil mantle. The many small rocks (erosion pavement) are the result of the removal of the finer elements of the soil.



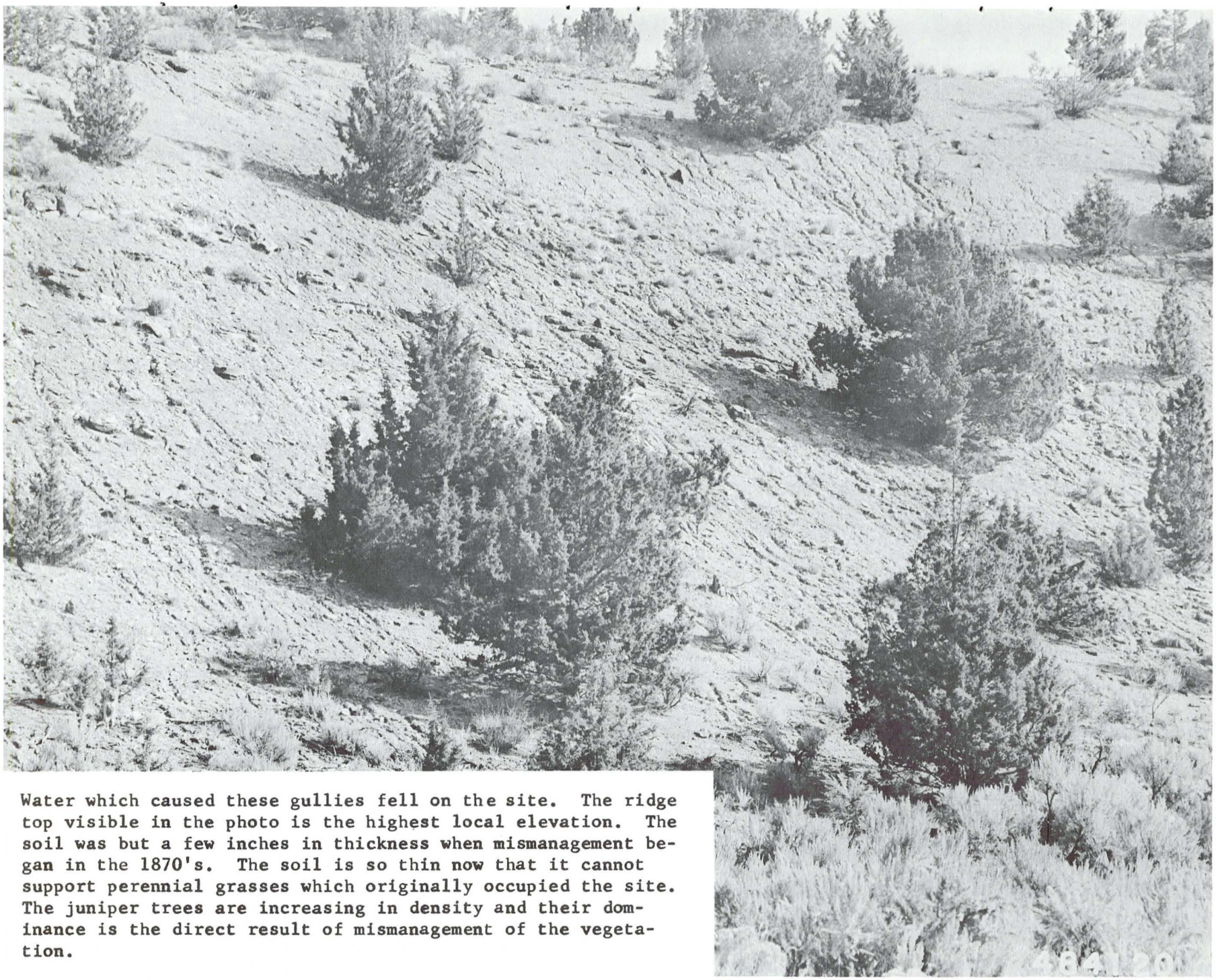
This close-up photo shows the distribution of rocks in the foot or more of soil. As the grass plants die, because of effects of overuse, the soil is carried away by wind and water. Charred bands of organic matter in the exposed soil profile attest to repeated fires through the centuries.



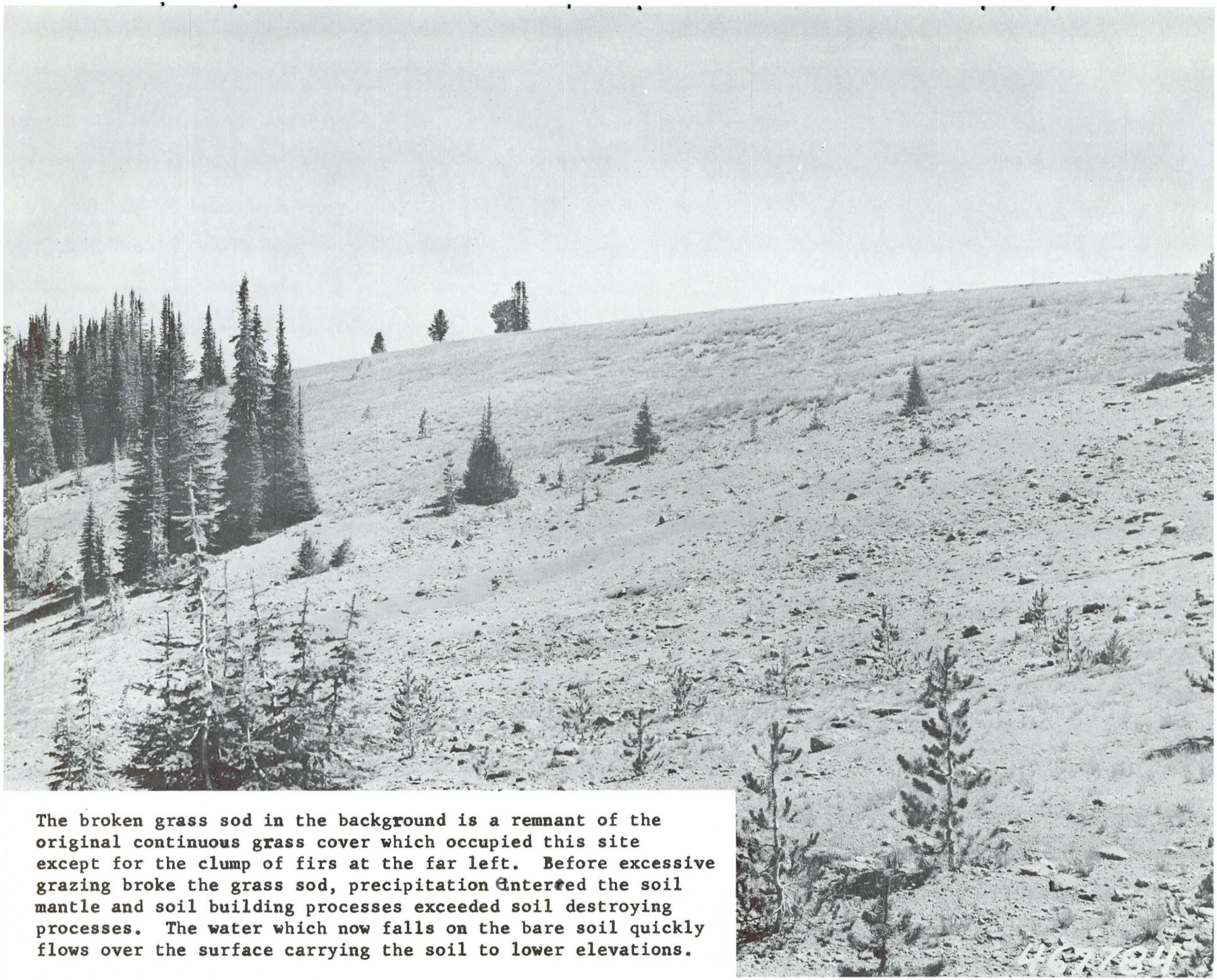
Soil which had accumulated to a depth of 18 inches during the many thousands of years before the advent of white man, was misplaced by accelerated erosion in a few decades following mismanagement. The exclusion of livestock had no noticeable effect once the sod cover was broken. Contour trenching, reseeding, and exclusion of livestock may be effective in slowing the rate of soil loss.



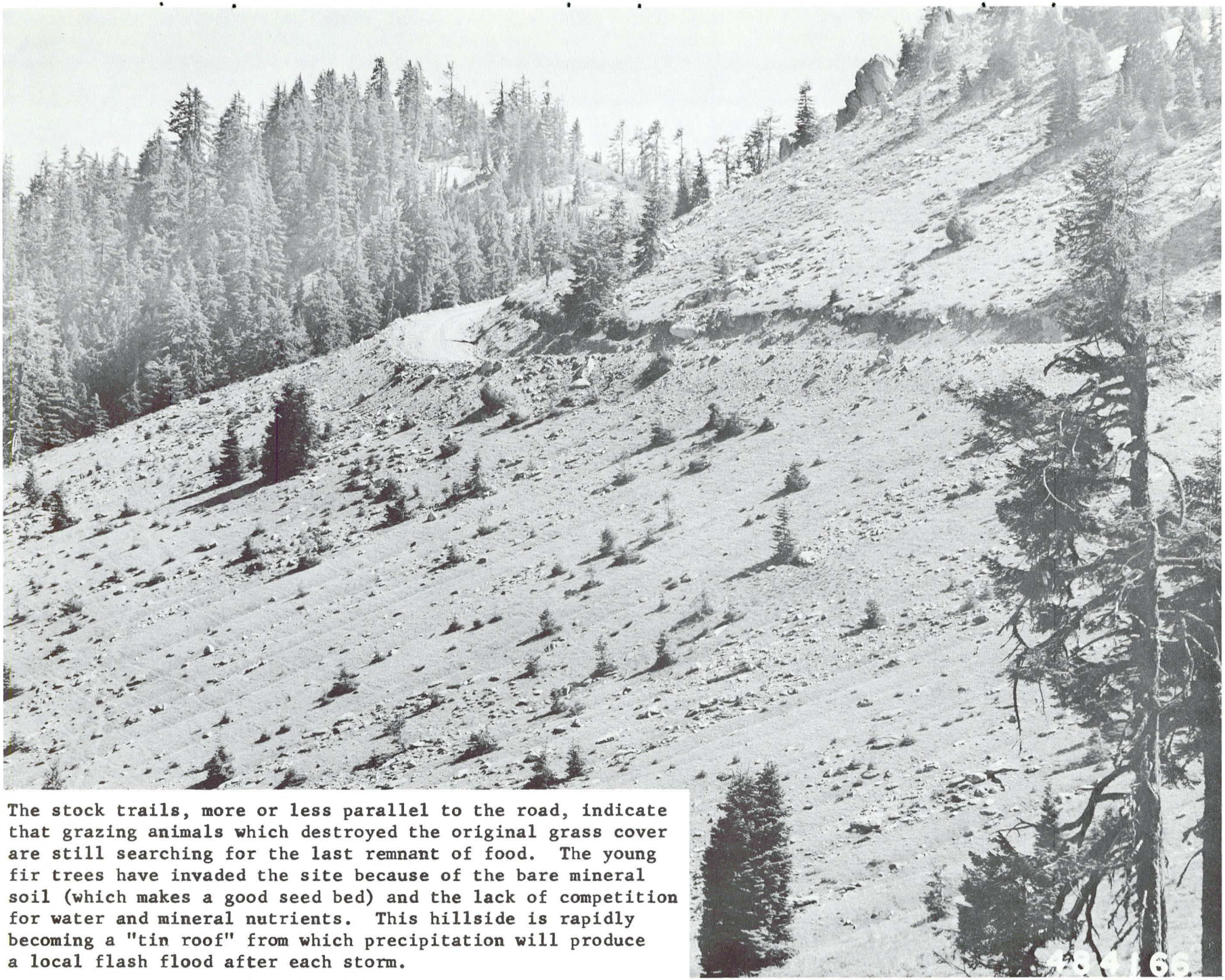
The soils in this eastern Oregon valley were more or less stable before white settlers started to graze flocks and herds on it in the late 1870's. The protective vegetative cover on the hillsides and in the valley was depleted by too many livestock that grazed too early and too long. Water which originally soaked into the ground, now runs over the surface carrying soil to new locations downstream. Unless drastic action (exclusion of livestock, control of big game, mechanical measures, tighter fire control) is taken, the entire soil mantle will be lost.



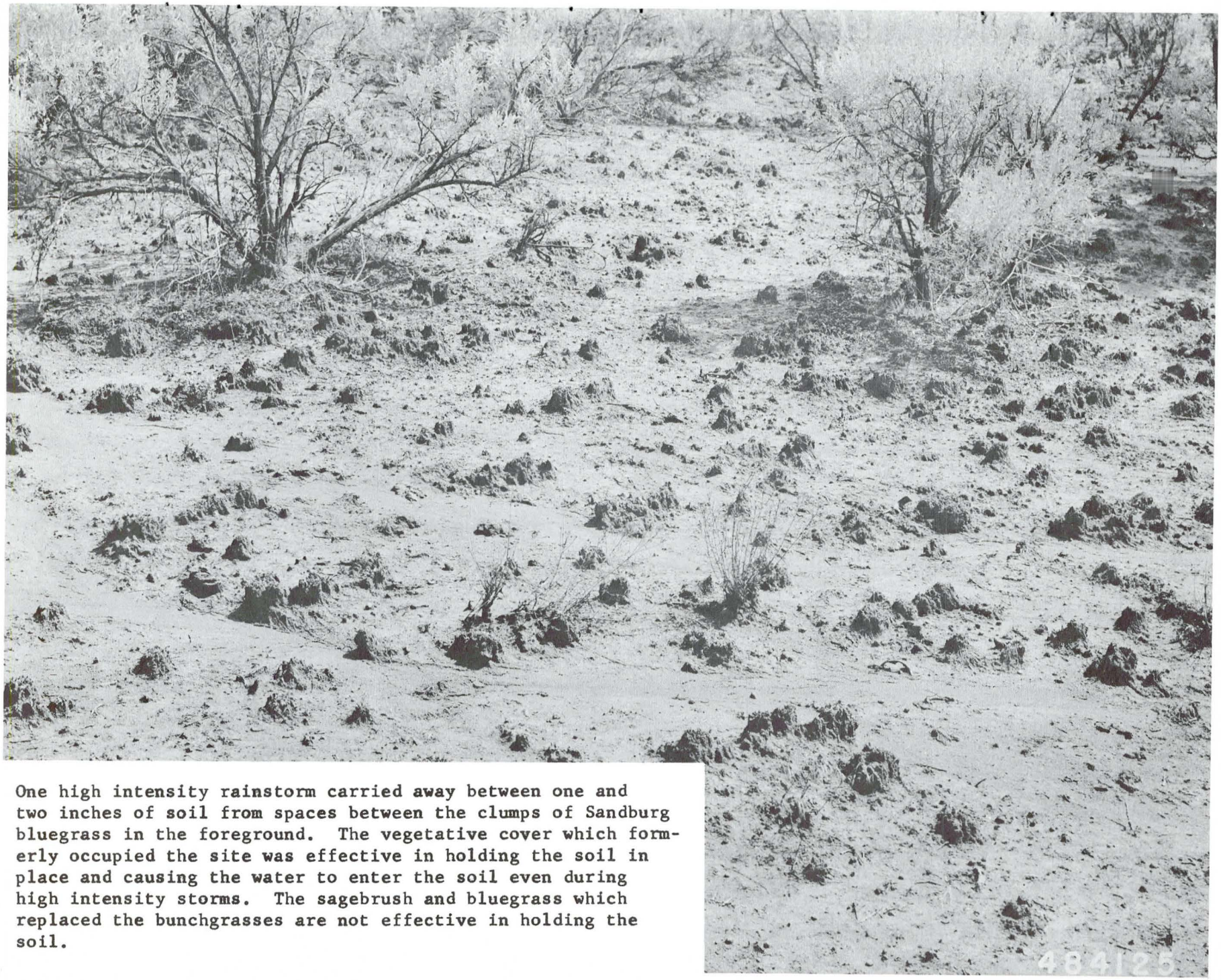
Water which caused these gullies fell on the site. The ridge top visible in the photo is the highest local elevation. The soil was but a few inches in thickness when mismanagement began in the 1870's. The soil is so thin now that it cannot support perennial grasses which originally occupied the site. The juniper trees are increasing in density and their dominance is the direct result of mismanagement of the vegetation.



The broken grass sod in the background is a remnant of the original continuous grass cover which occupied this site except for the clump of firs at the far left. Before excessive grazing broke the grass sod, precipitation entered the soil mantle and soil building processes exceeded soil destroying processes. The water which now falls on the bare soil quickly flows over the surface carrying the soil to lower elevations.

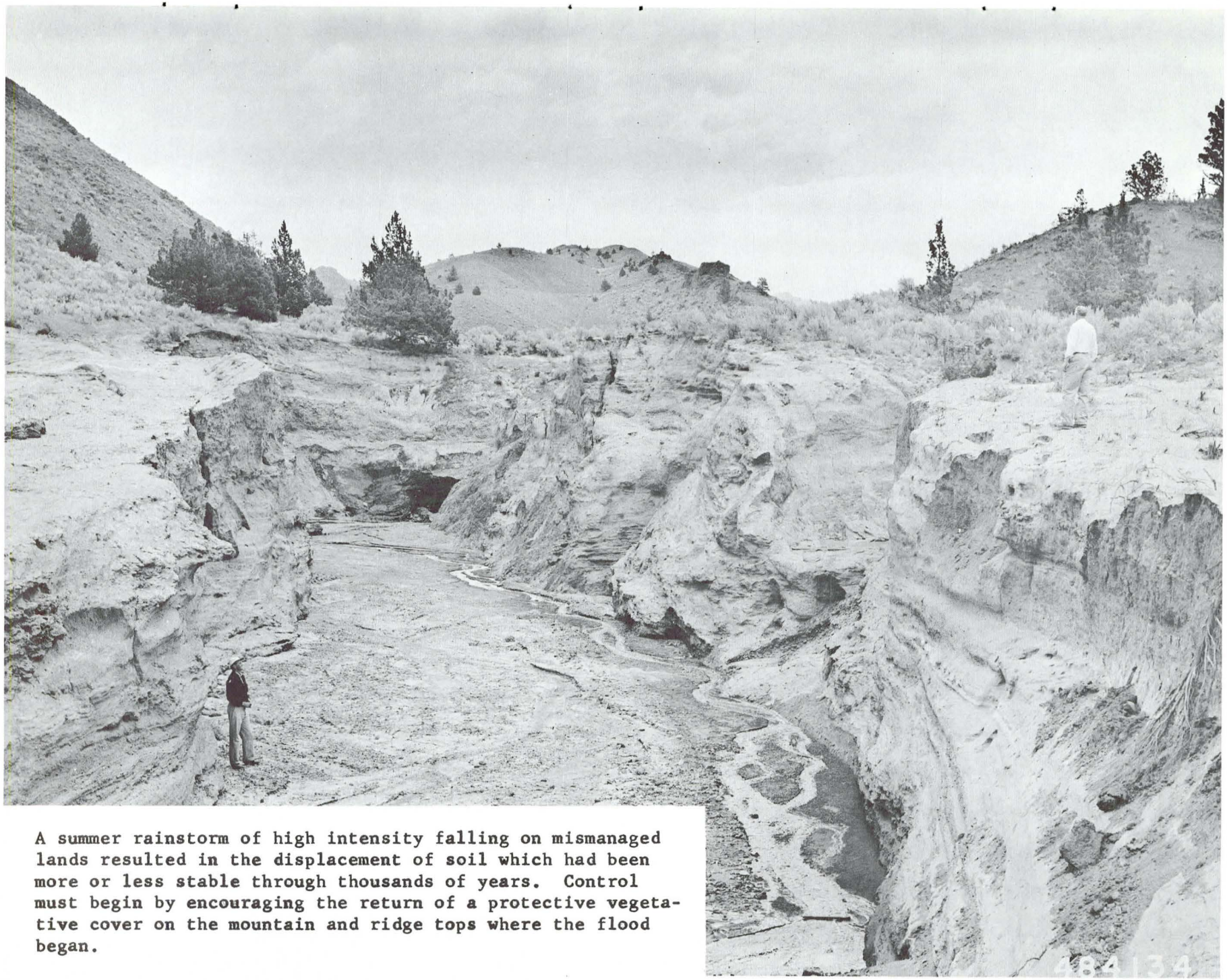


The stock trails, more or less parallel to the road, indicate that grazing animals which destroyed the original grass cover are still searching for the last remnant of food. The young fir trees have invaded the site because of the bare mineral soil (which makes a good seed bed) and the lack of competition for water and mineral nutrients. This hillside is rapidly becoming a "tin roof" from which precipitation will produce a local flash flood after each storm.



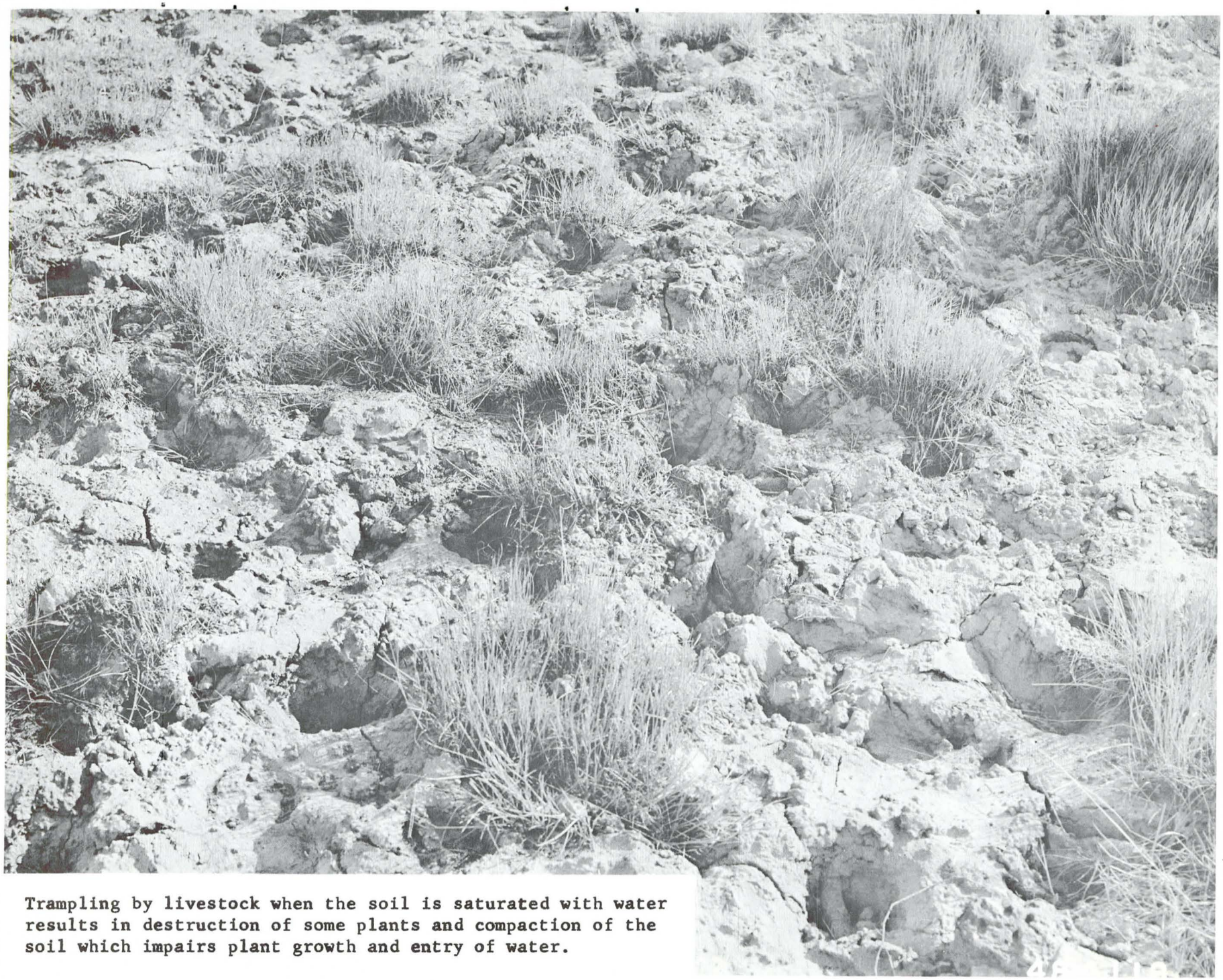
One high intensity rainstorm carried away between one and two inches of soil from spaces between the clumps of Sandburg bluegrass in the foreground. The vegetative cover which formerly occupied the site was effective in holding the soil in place and causing the water to enter the soil even during high intensity storms. The sagebrush and bluegrass which replaced the bunchgrasses are not effective in holding the soil.

484125



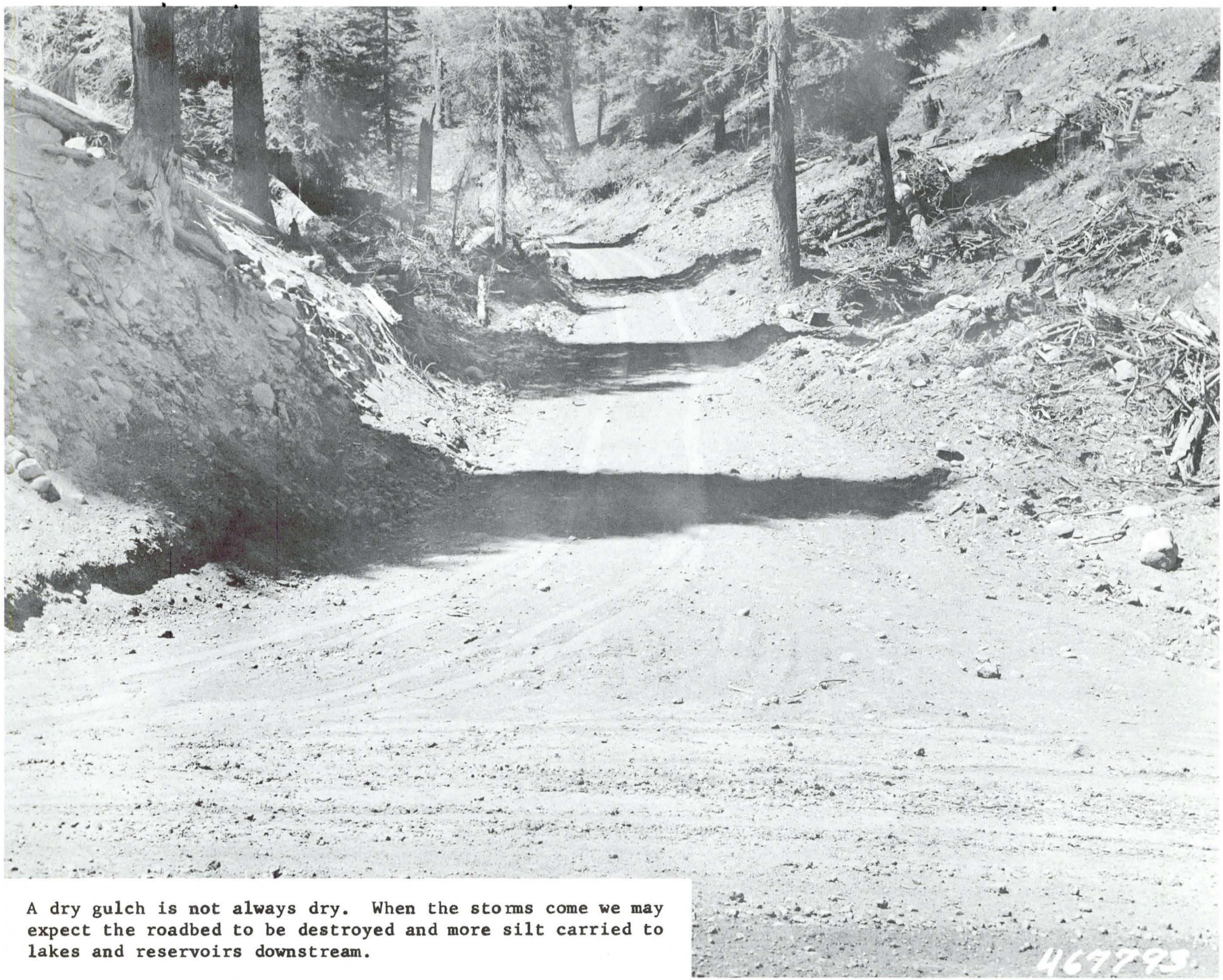
A summer rainstorm of high intensity falling on mismanaged lands resulted in the displacement of soil which had been more or less stable through thousands of years. Control must begin by encouraging the return of a protective vegetative cover on the mountain and ridge tops where the flood began.

484134

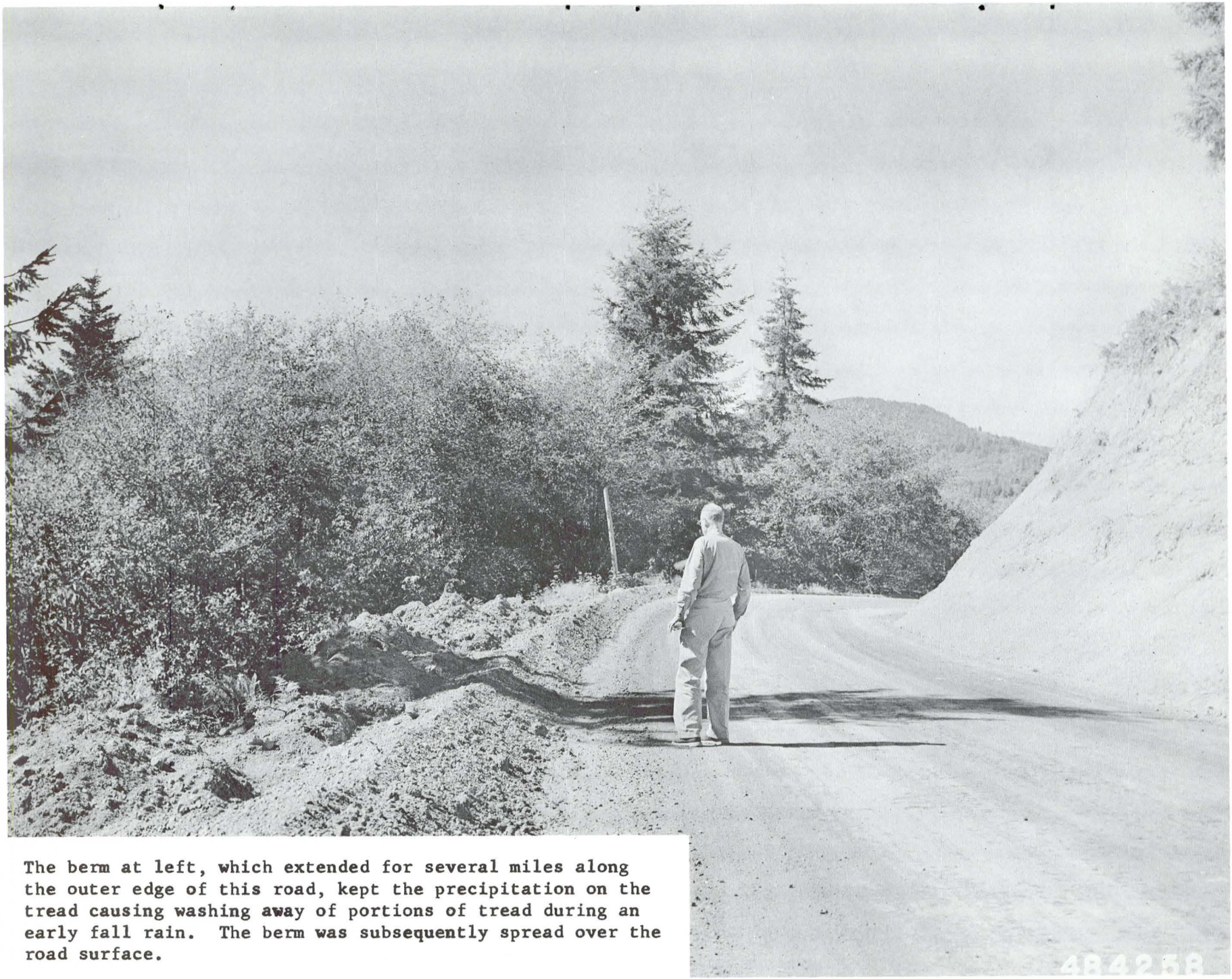


Trampling by livestock when the soil is saturated with water results in destruction of some plants and compaction of the soil which impairs plant growth and entry of water.

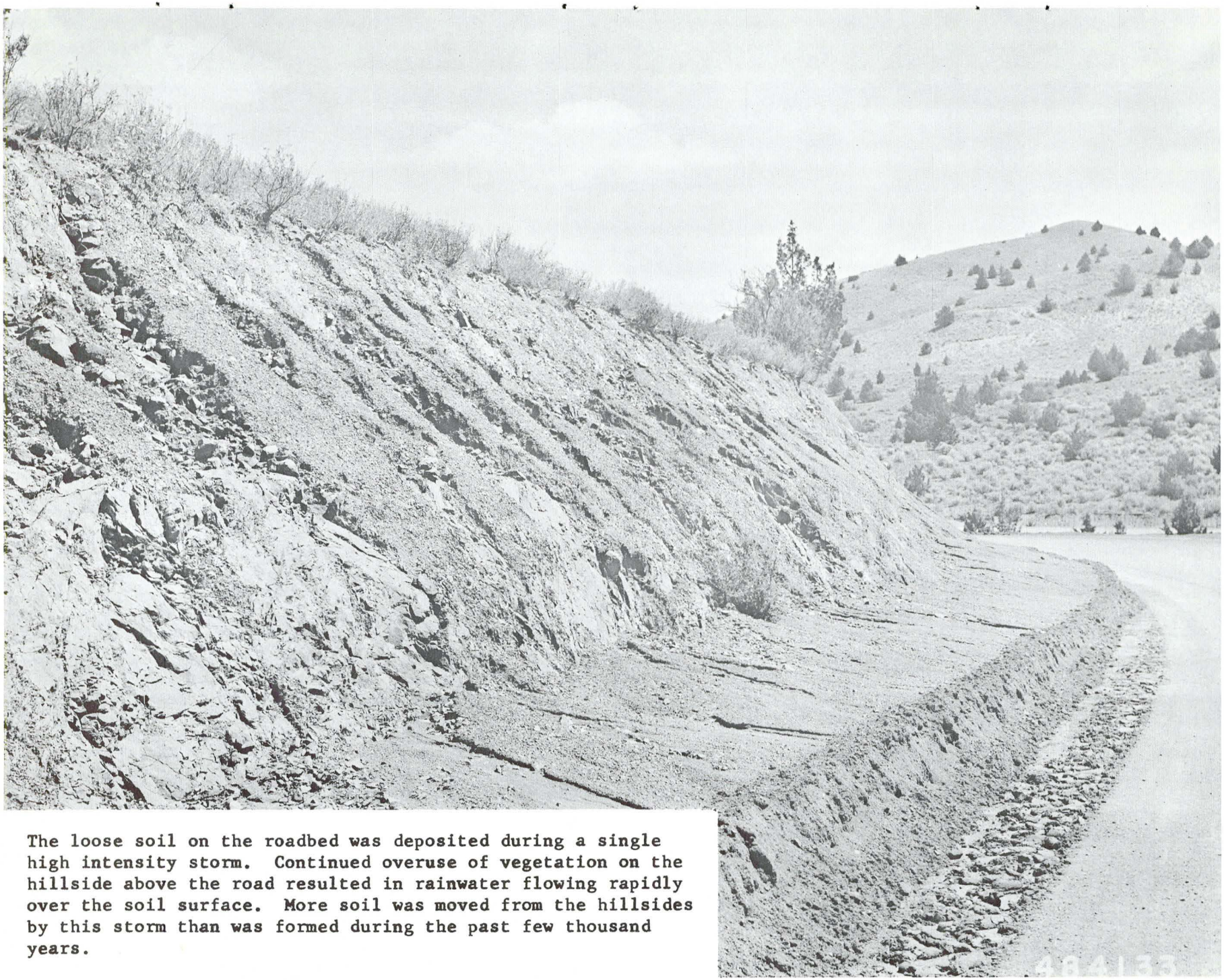
Many mountain meadows are the result of beaver activity. Beaver dams held back the mountain water and collected sediment which replaced the pools. Beaver colonies are still beneficial in maintaining high-water tables and stabilizing streamflow. They are generally not welcome in municipal watersheds because they increase organic matter and the number of coliform bacteria in the water.



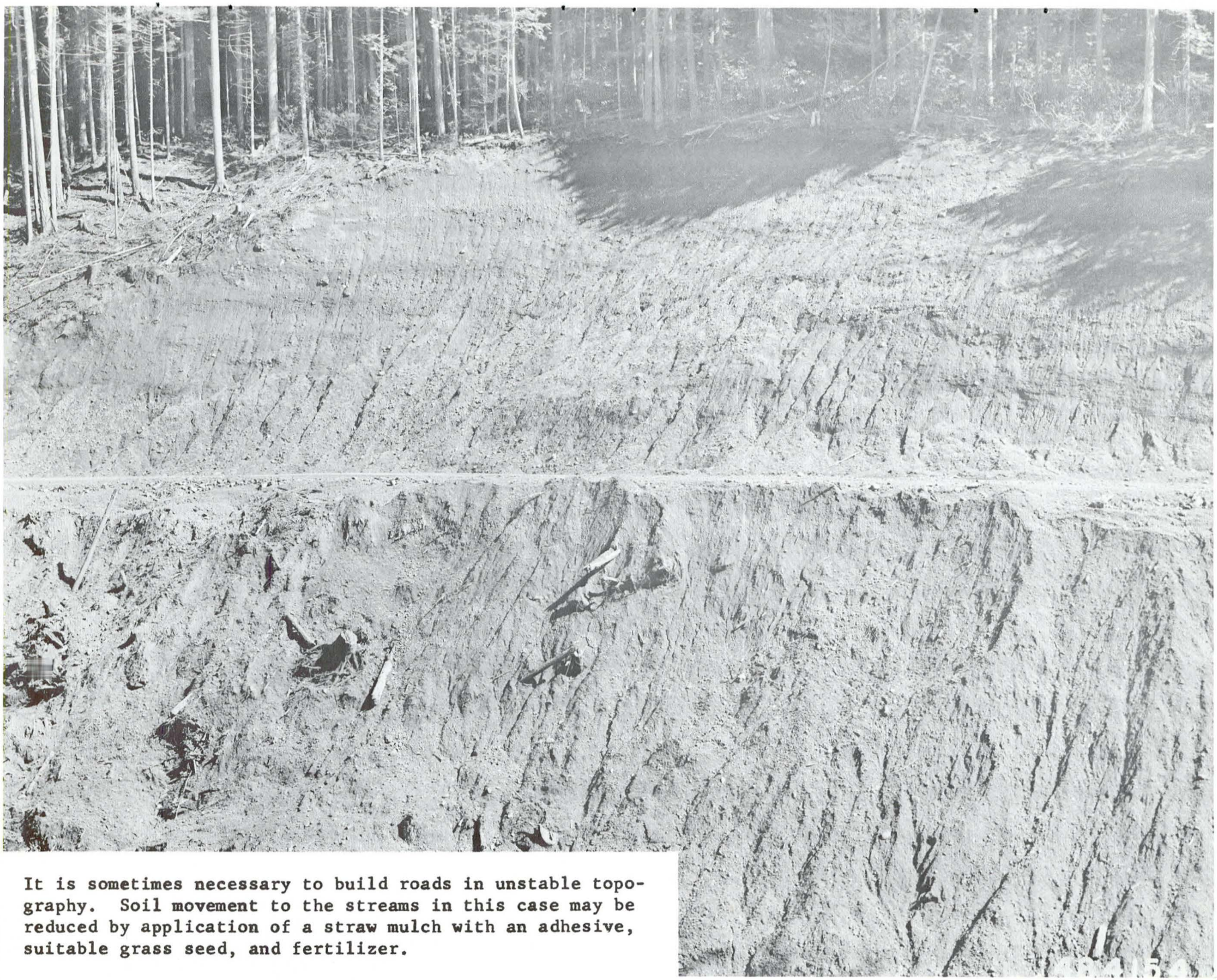
A dry gulch is not always dry. When the storms come we may expect the roadbed to be destroyed and more silt carried to lakes and reservoirs downstream.



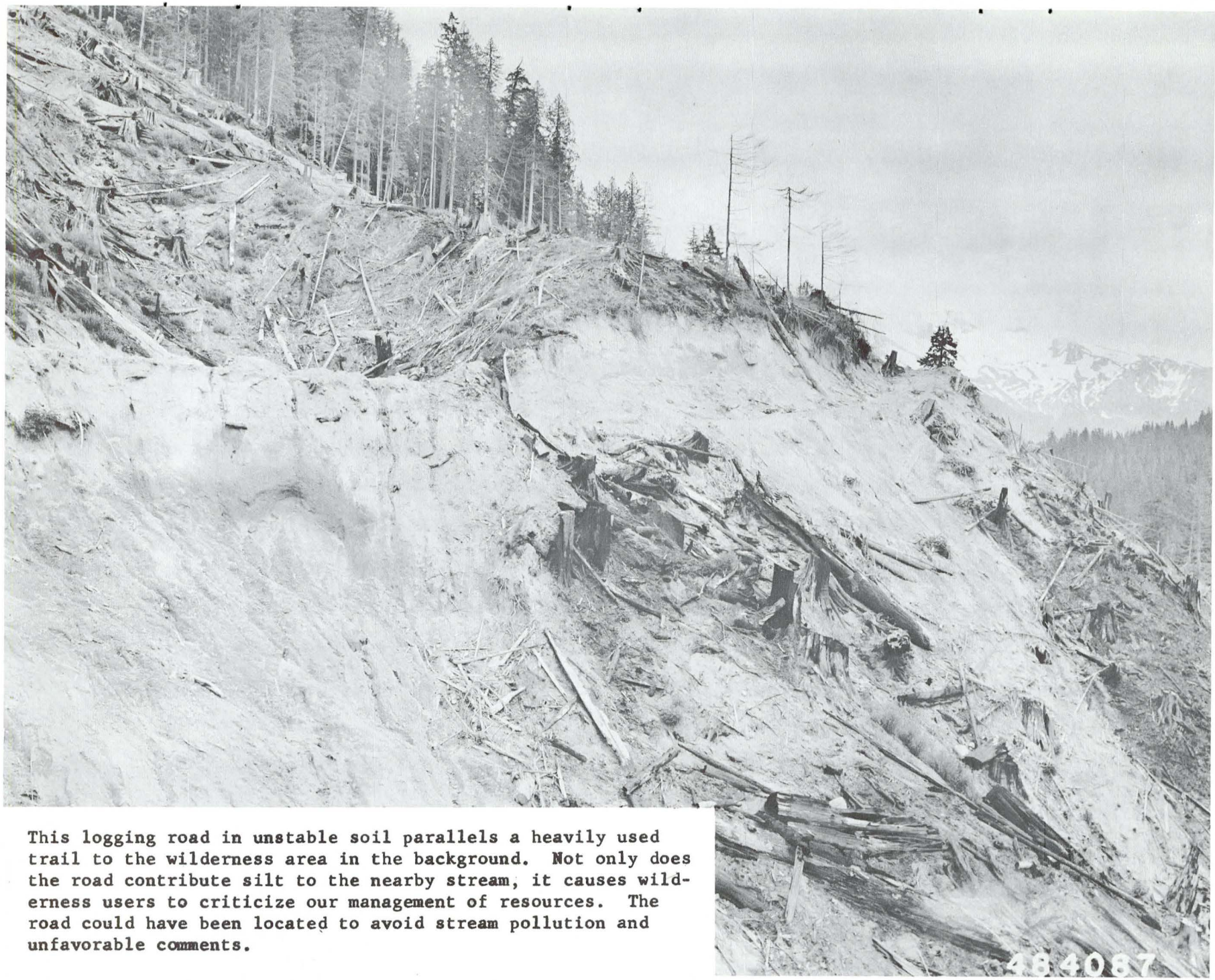
The berm at left, which extended for several miles along the outer edge of this road, kept the precipitation on the tread causing washing away of portions of tread during an early fall rain. The berm was subsequently spread over the road surface.



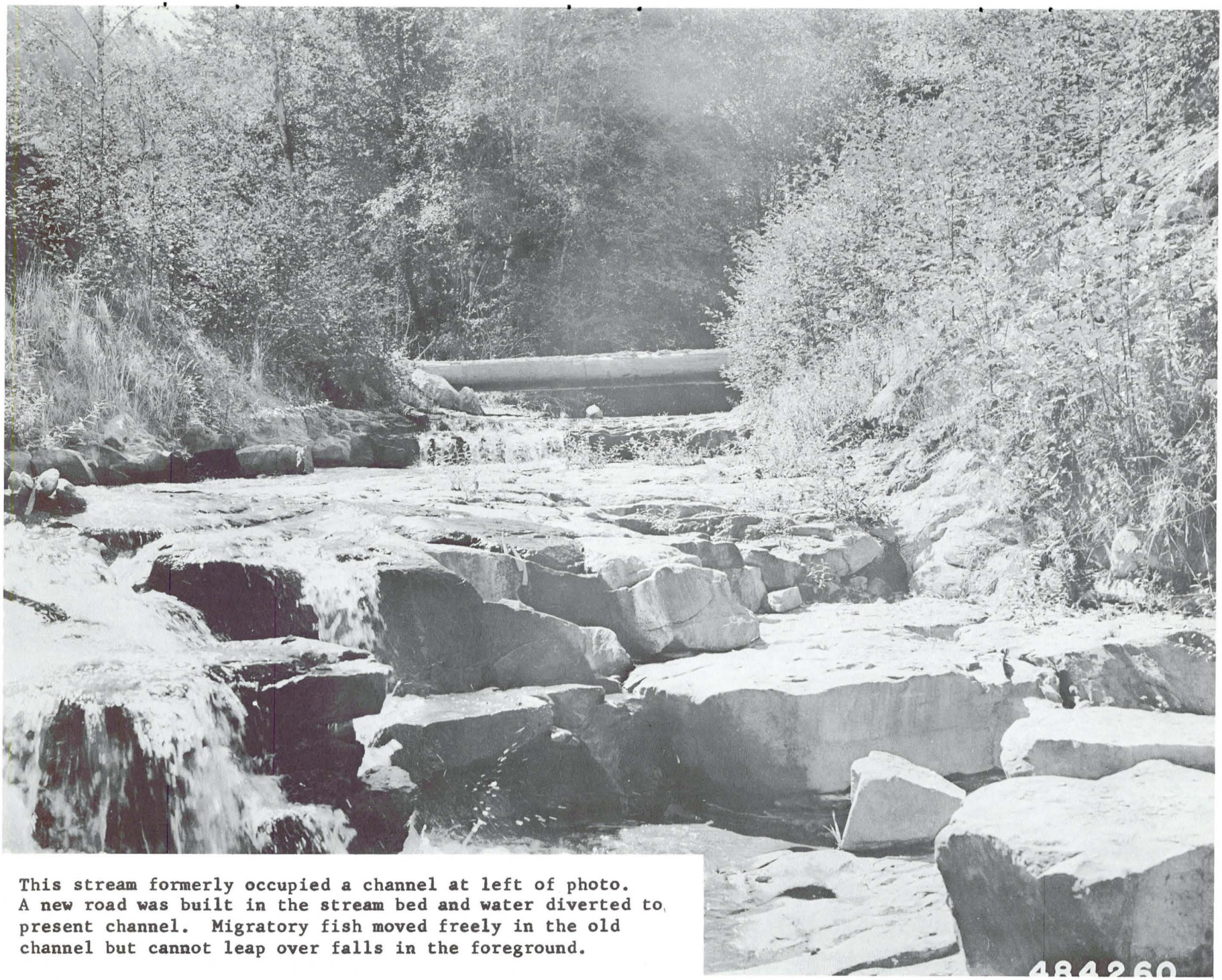
The loose soil on the roadbed was deposited during a single high intensity storm. Continued overuse of vegetation on the hillside above the road resulted in rainwater flowing rapidly over the soil surface. More soil was moved from the hillsides by this storm than was formed during the past few thousand years.



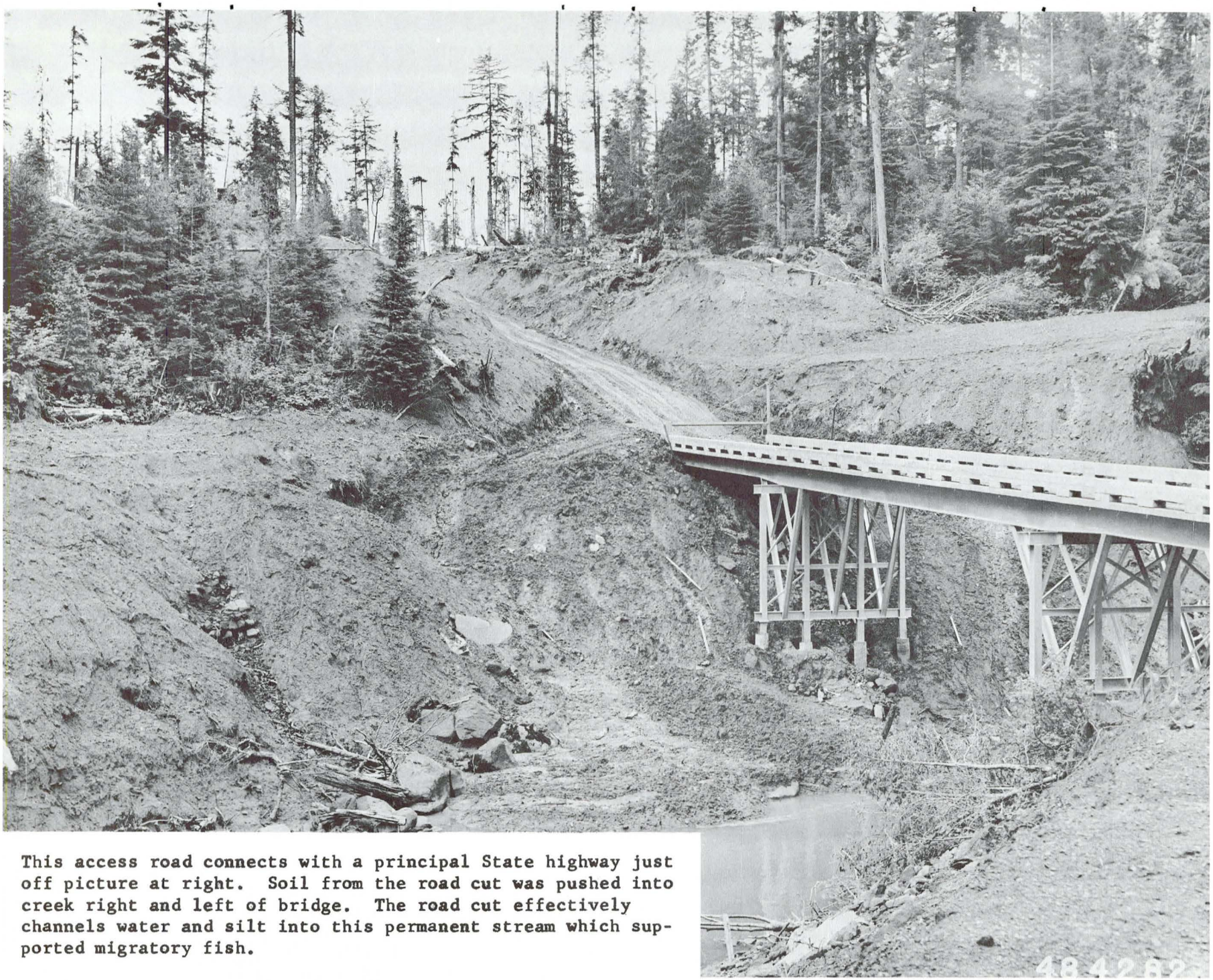
It is sometimes necessary to build roads in unstable topography. Soil movement to the streams in this case may be reduced by application of a straw mulch with an adhesive, suitable grass seed, and fertilizer.



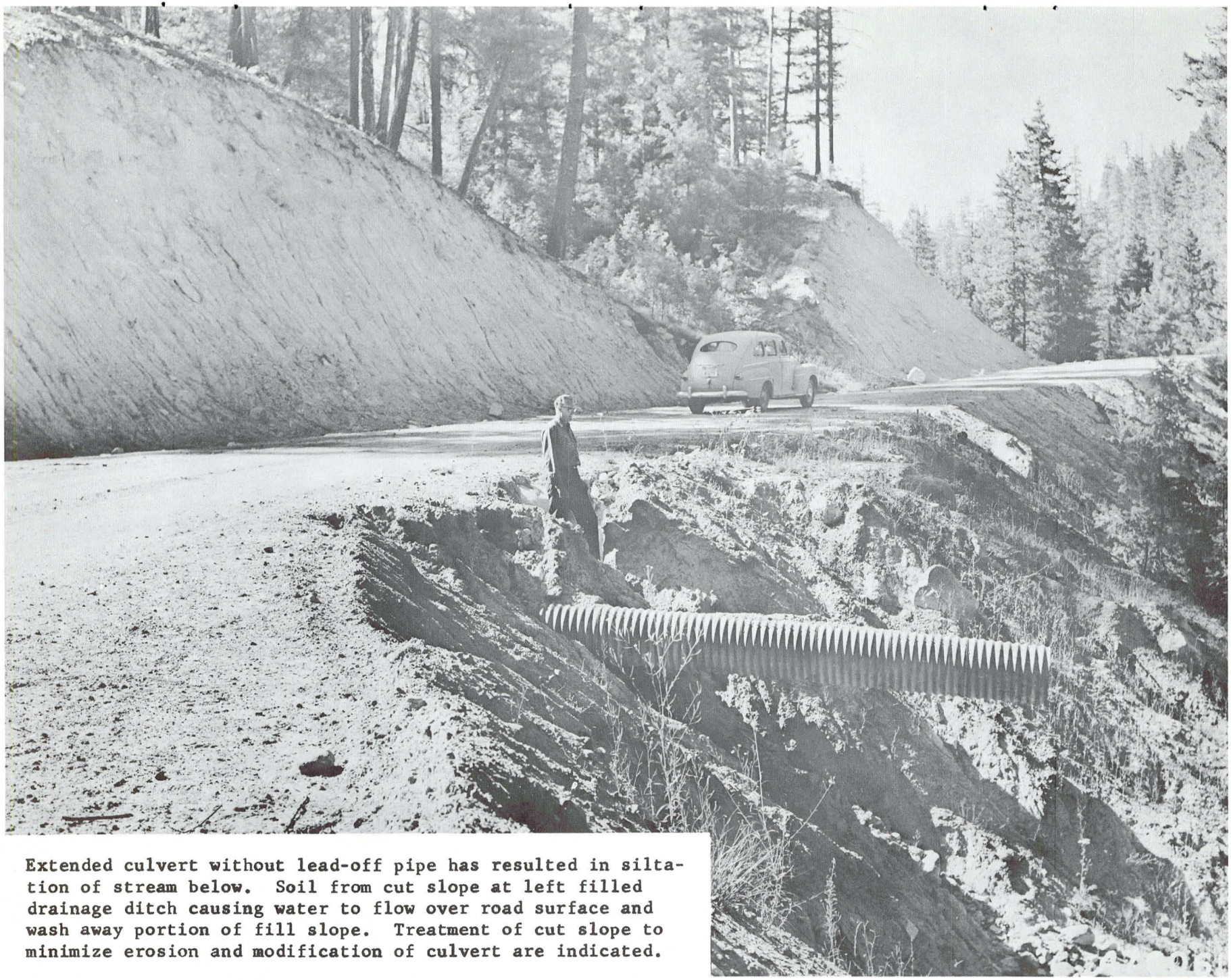
This logging road in unstable soil parallels a heavily used trail to the wilderness area in the background. Not only does the road contribute silt to the nearby stream, it causes wilderness users to criticize our management of resources. The road could have been located to avoid stream pollution and unfavorable comments.



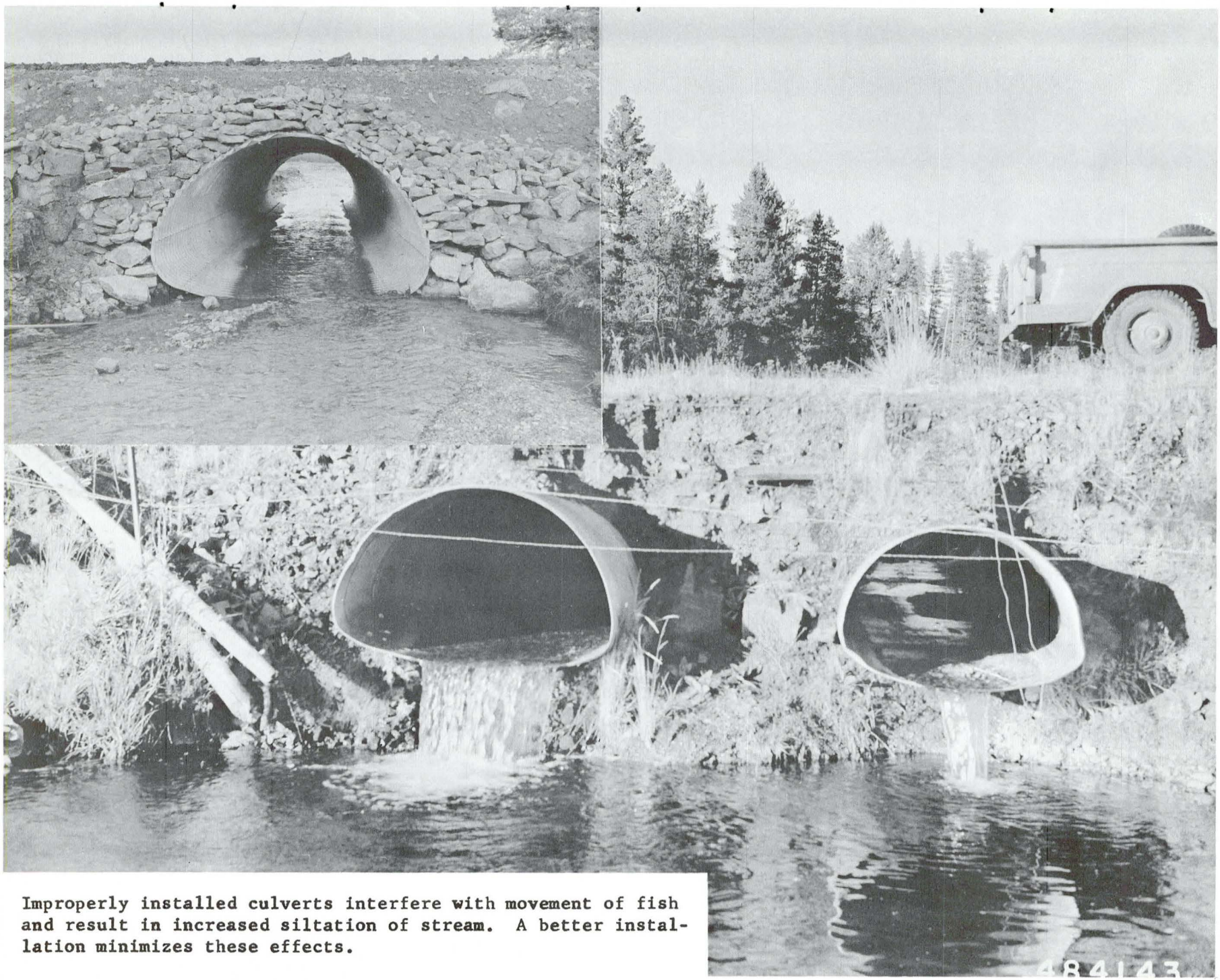
This stream formerly occupied a channel at left of photo. A new road was built in the stream bed and water diverted to present channel. Migratory fish moved freely in the old channel but cannot leap over falls in the foreground.



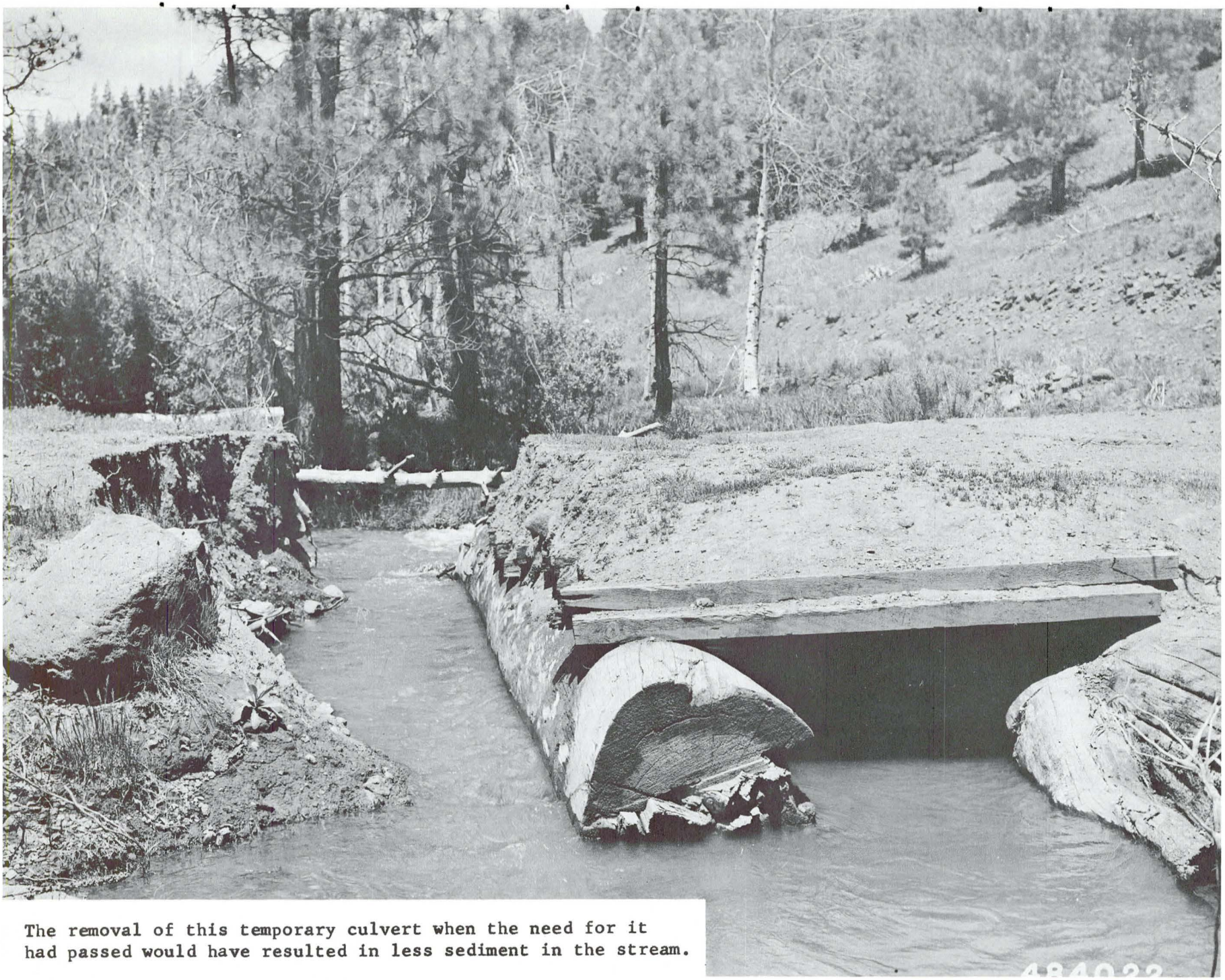
This access road connects with a principal State highway just off picture at right. Soil from the road cut was pushed into creek right and left of bridge. The road cut effectively channels water and silt into this permanent stream which supported migratory fish.



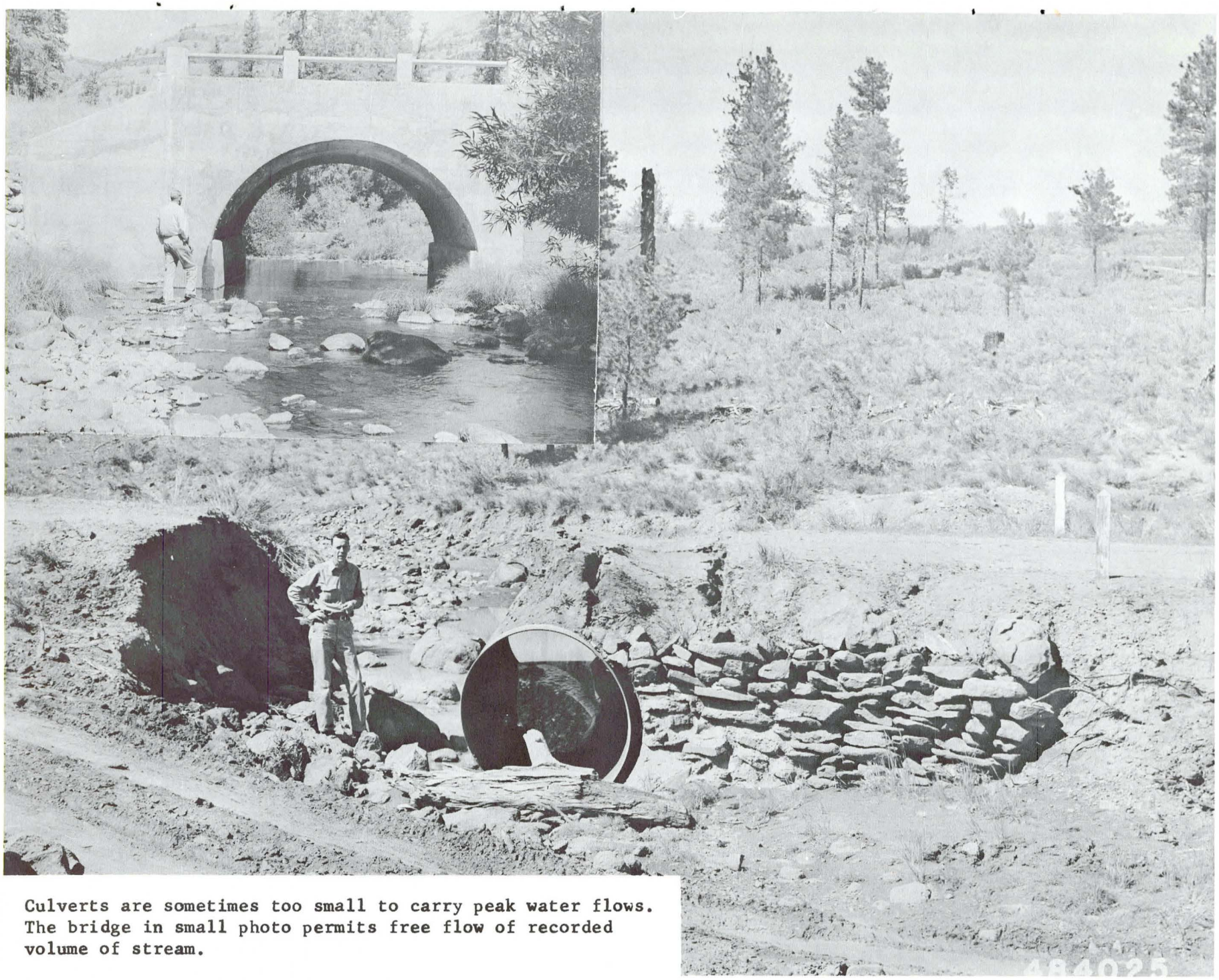
Extended culvert without lead-off pipe has resulted in siltation of stream below. Soil from cut slope at left filled drainage ditch causing water to flow over road surface and wash away portion of fill slope. Treatment of cut slope to minimize erosion and modification of culvert are indicated.



Improperly installed culverts interfere with movement of fish and result in increased siltation of stream. A better installation minimizes these effects.



The removal of this temporary culvert when the need for it had passed would have resulted in less sediment in the stream.



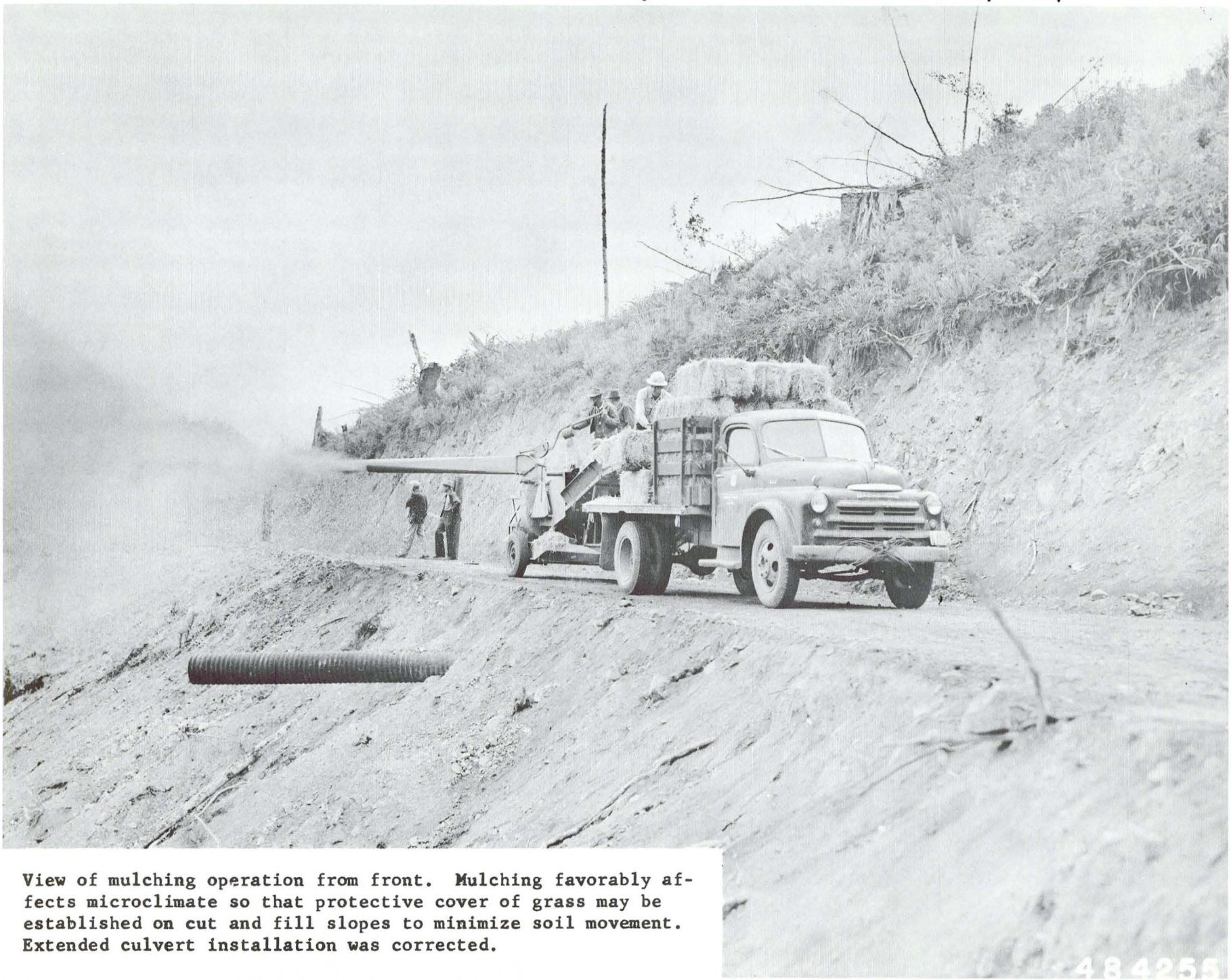
Culverts are sometimes too small to carry peak water flows. The bridge in small photo permits free flow of recorded volume of stream.

A case of cause and effect in culvert installation.

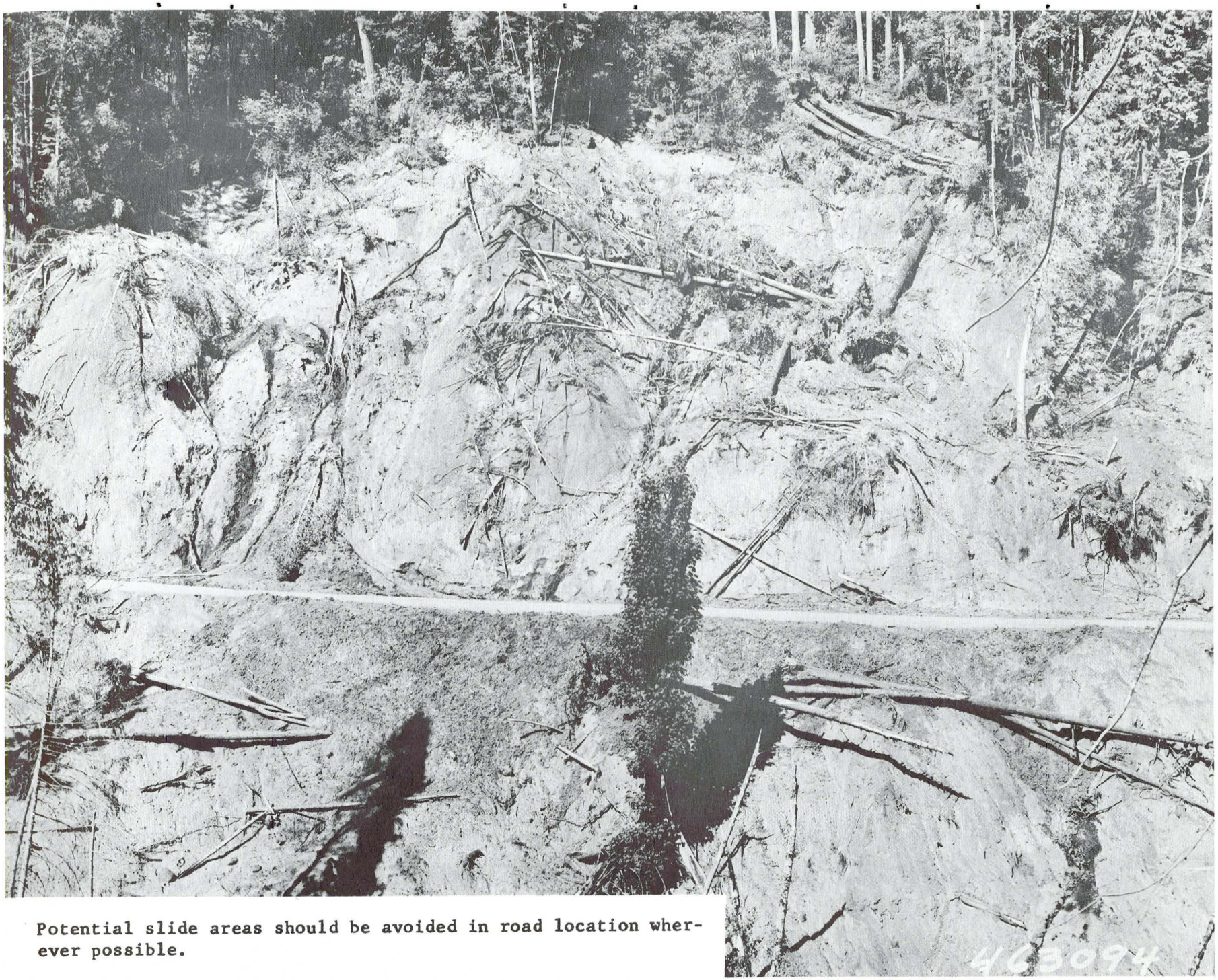
Debris in the stream has directed water toward road, resulting in bank cutting. Insert shows coastal stream wearing away fill slope of newly constructed road. Expensive cribbing will perhaps be necessary to protect road.

The concentration of too much water in road drainage ditches causes tons of soil to reach the streams.

Mulching machine in operation on newly constructed road. Four-man crew consists of truck driver, supply man (on truck), machine feeder (partly out of sight), and nozzle operator.



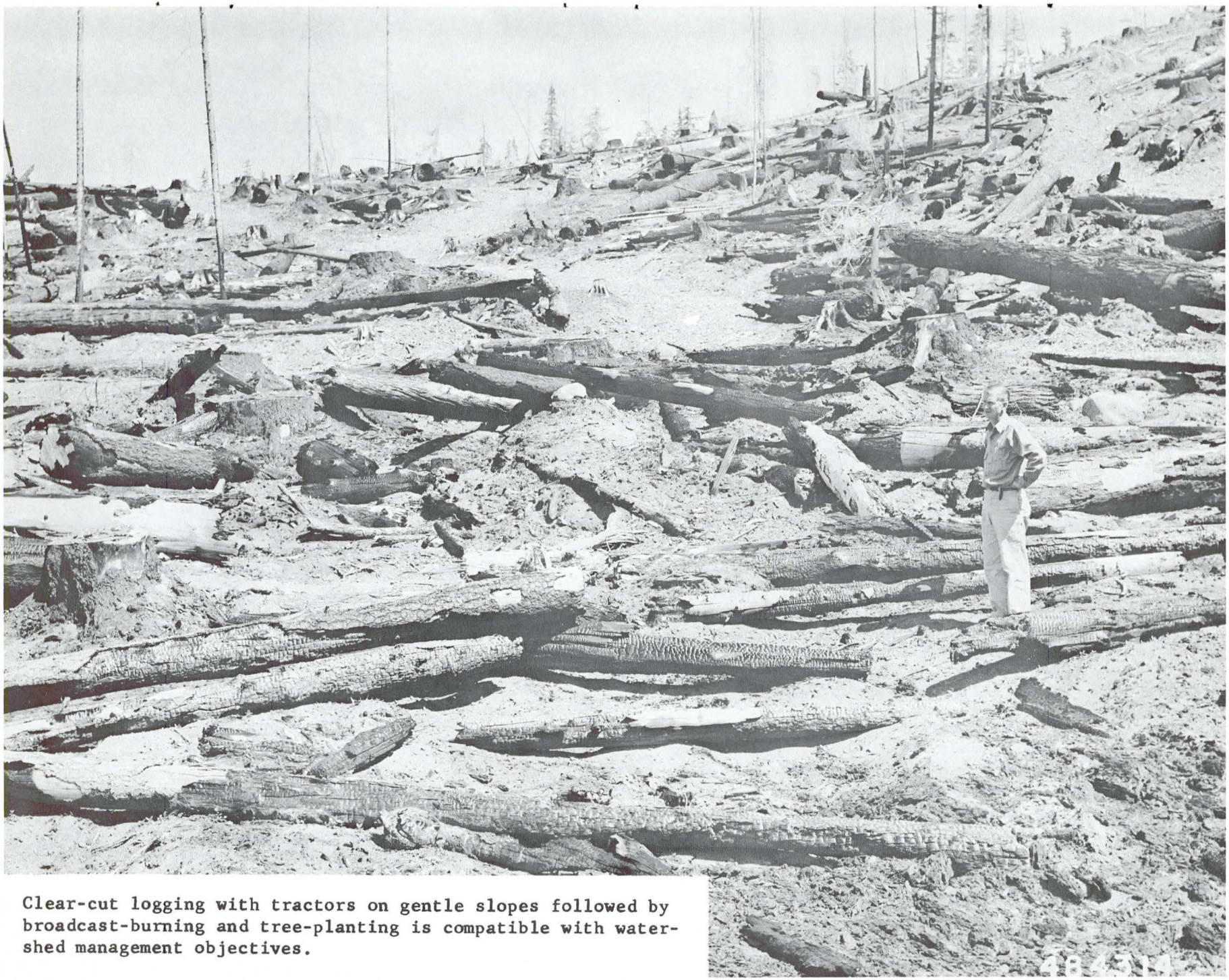
View of mulching operation from front. Mulching favorably affects microclimate so that protective cover of grass may be established on cut and fill slopes to minimize soil movement. Extended culvert installation was corrected.



Potential slide areas should be avoided in road location wherever possible.

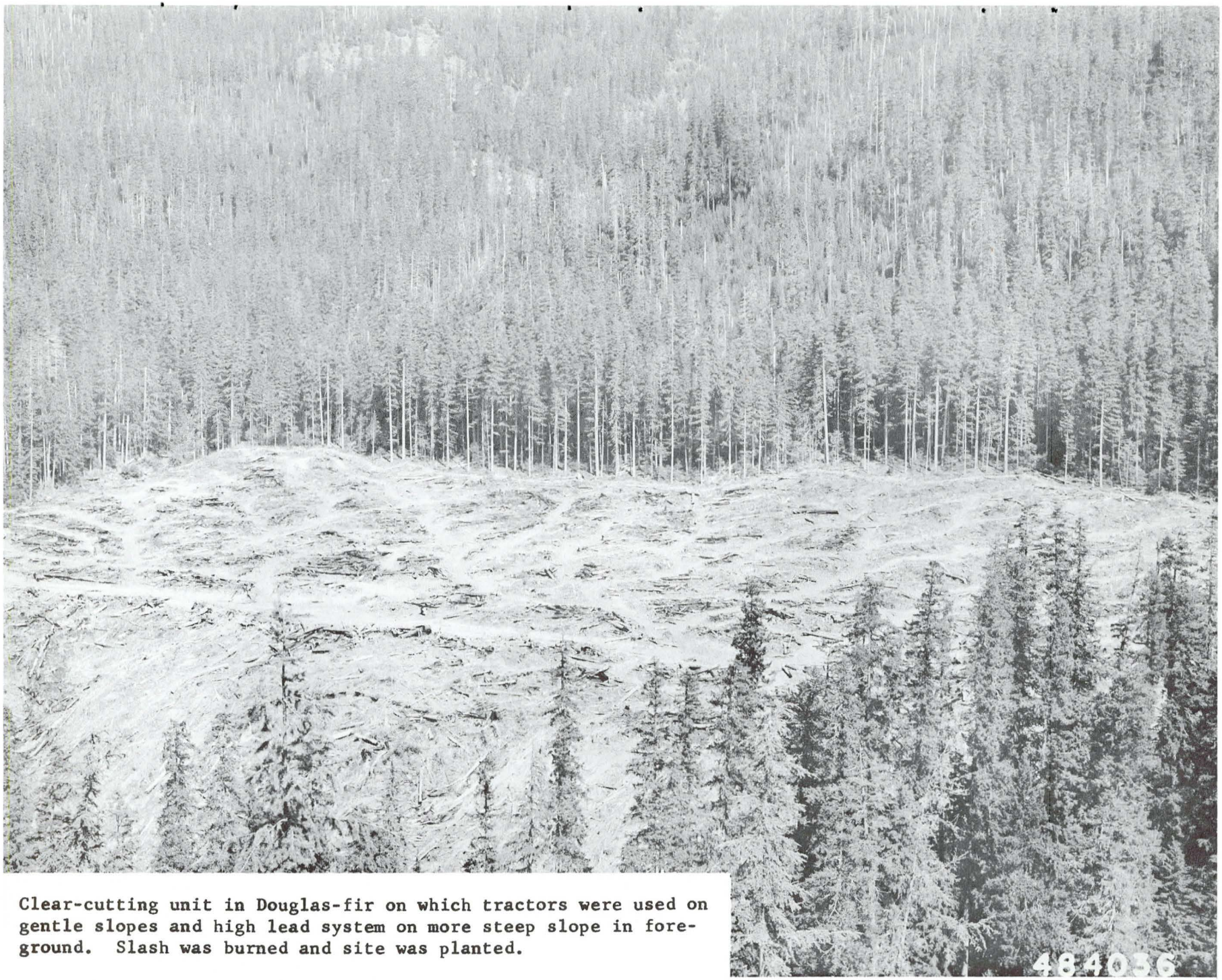
Where it is impossible to avoid slide areas in road location, measures should be employed to reduce costs of maintenance and siltation of streams.

Controlled fire is used to remove slash from this clear-cutting unit. The fire will make it possible to replant the site and produce a new crop of timber with minimum delay. The soil is not necessarily damaged by controlled burning if properly done.

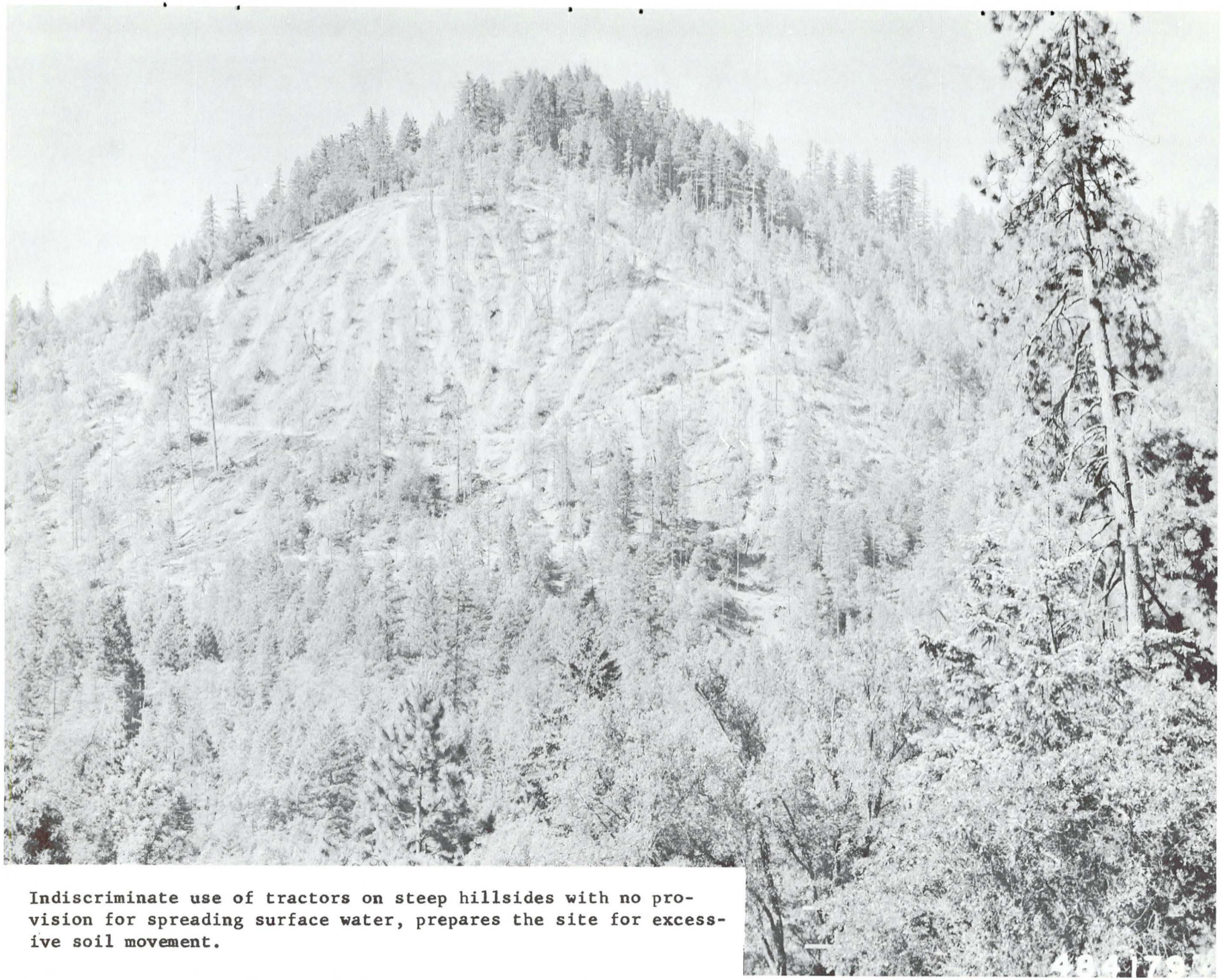


Clear-cut logging with tractors on gentle slopes followed by broadcast-burning and tree-planting is compatible with watershed management objectives.

Drainage of skidtrails and logging spur roads is a necessary part of timber sale administration. This must be done before first period of heavy precipitation and while equipment is in the area.

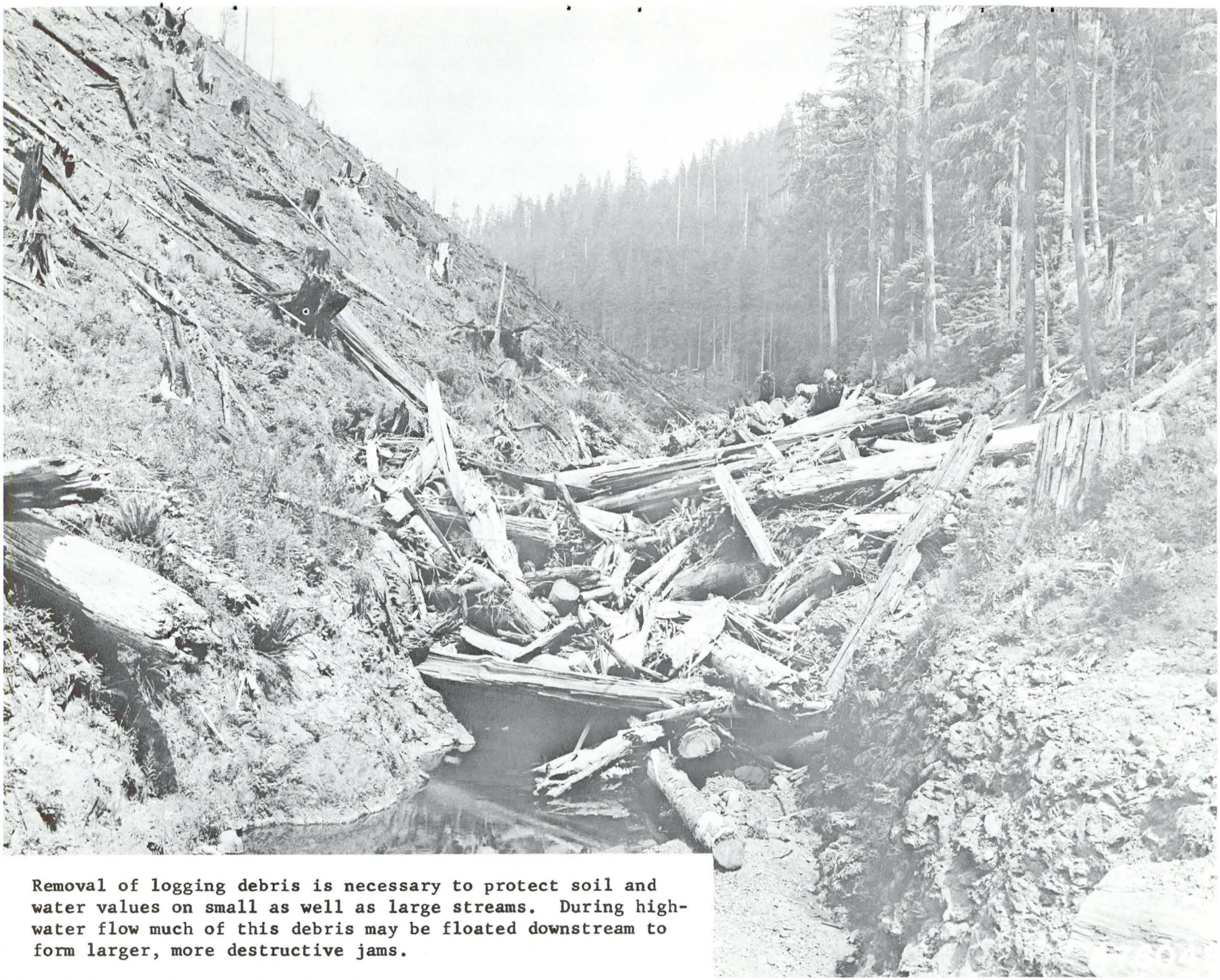


Clear-cutting unit in Douglas-fir on which tractors were used on gentle slopes and high lead system on more steep slope in foreground. Slash was burned and site was planted.

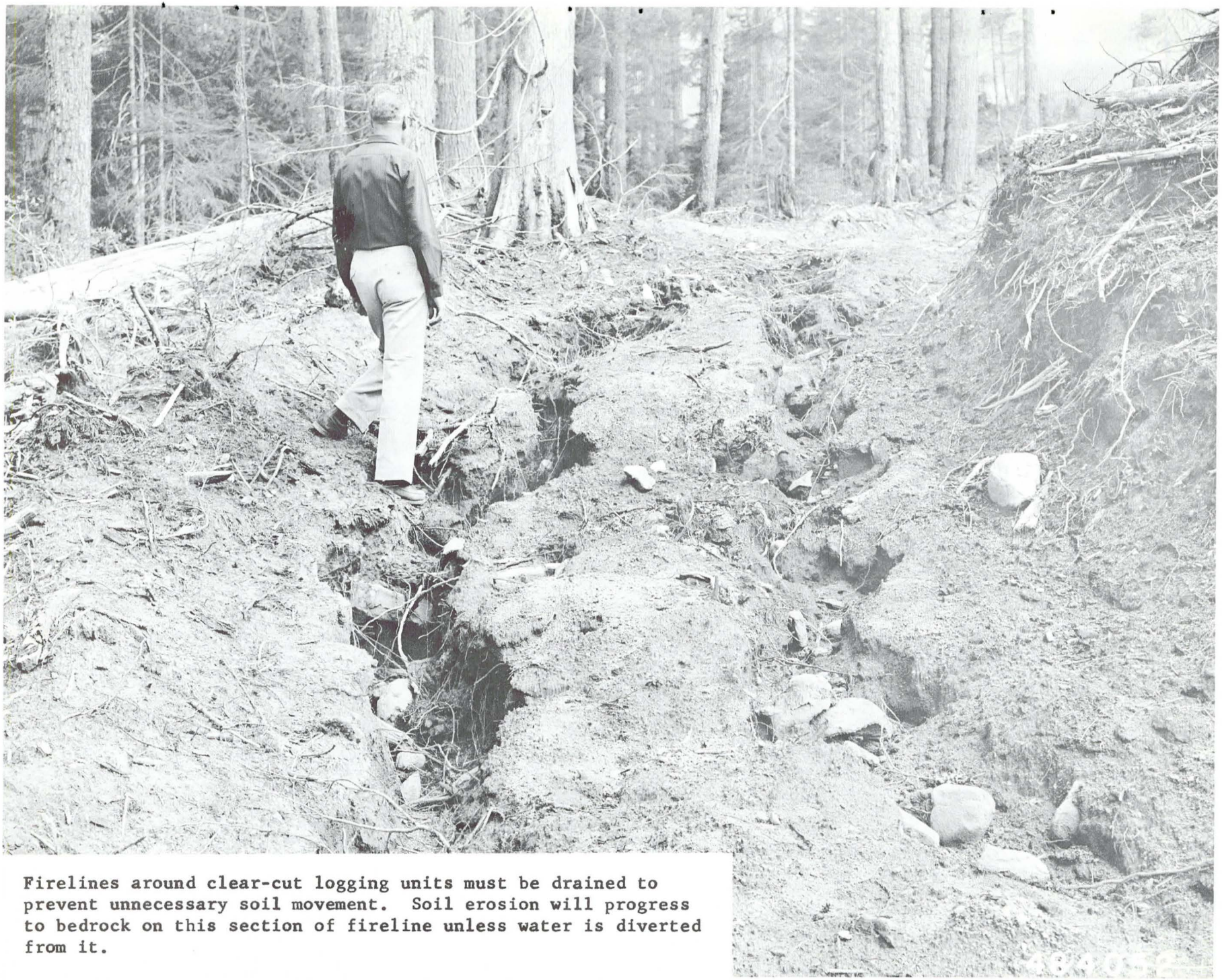


Indiscriminate use of tractors on steep hillsides with no provision for spreading surface water, prepares the site for excessive soil movement.

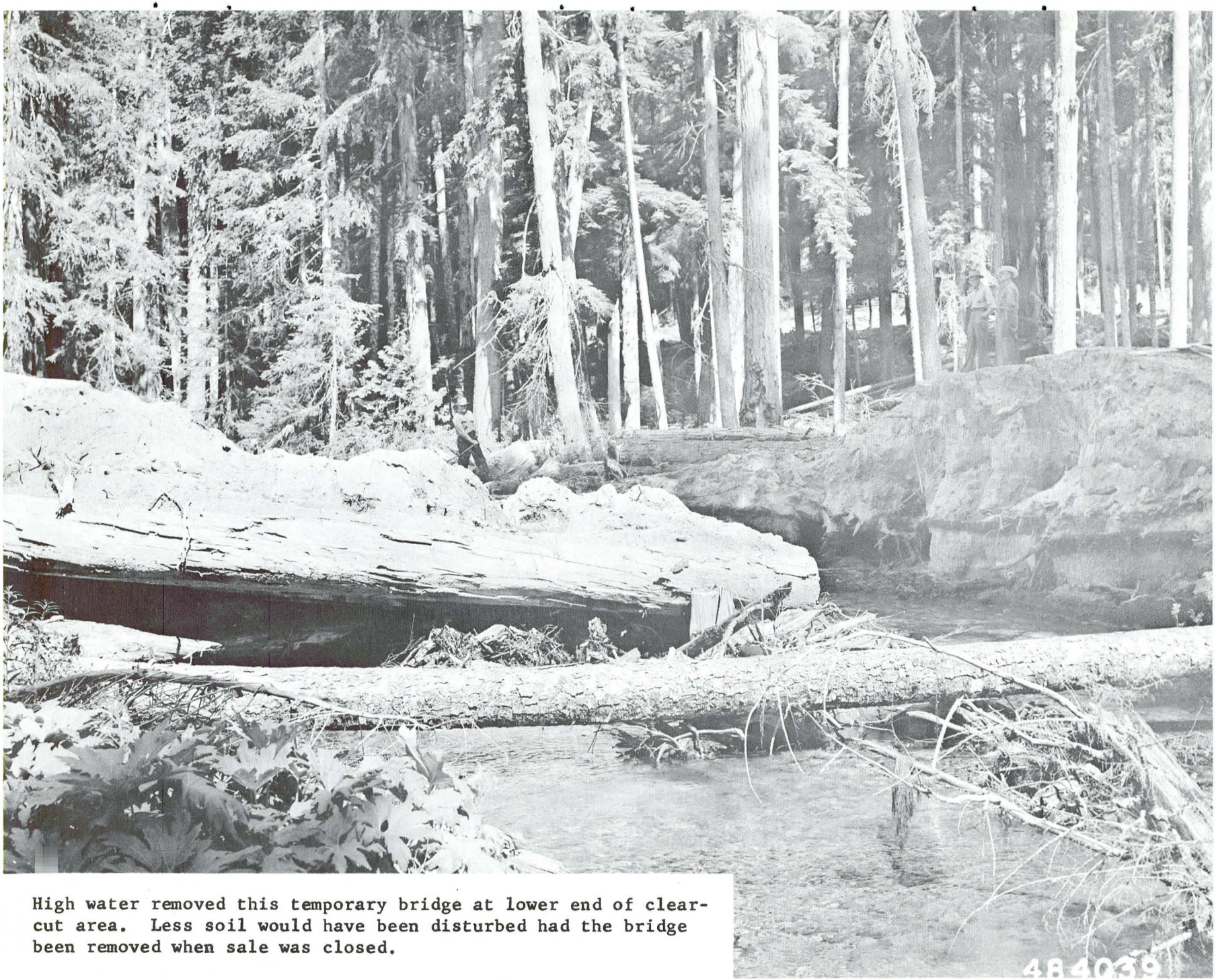
High-lead logging uphill spreads rather than concentrates surface water flow as in the case of tractor logging. Soil and litter are disturbed but little and precipitation enters the soil mantle quickly.



Removal of logging debris is necessary to protect soil and water values on small as well as large streams. During high-water flow much of this debris may be floated downstream to form larger, more destructive jams.

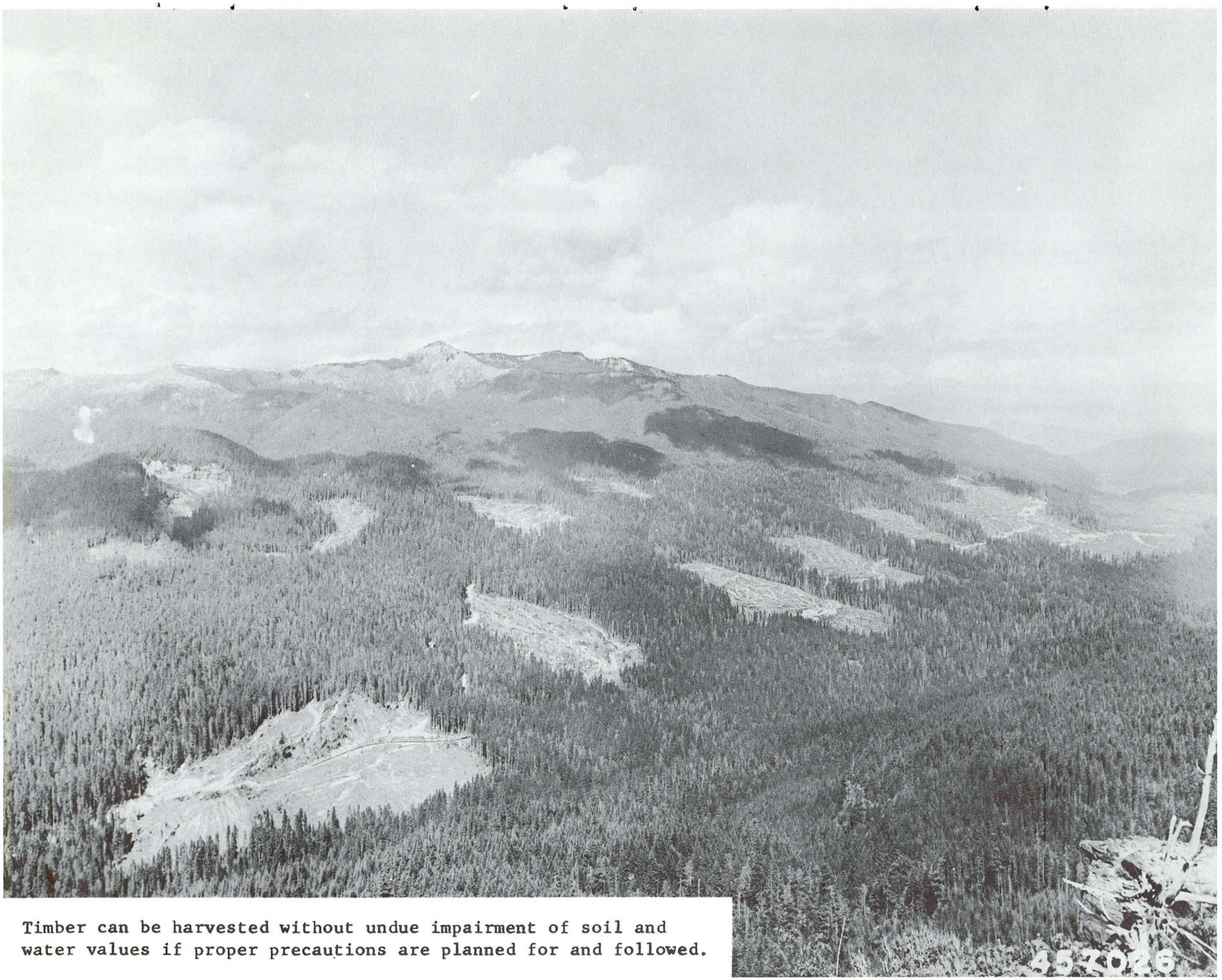


Firelines around clear-cut logging units must be drained to prevent unnecessary soil movement. Soil erosion will progress to bedrock on this section of fireline unless water is diverted from it.



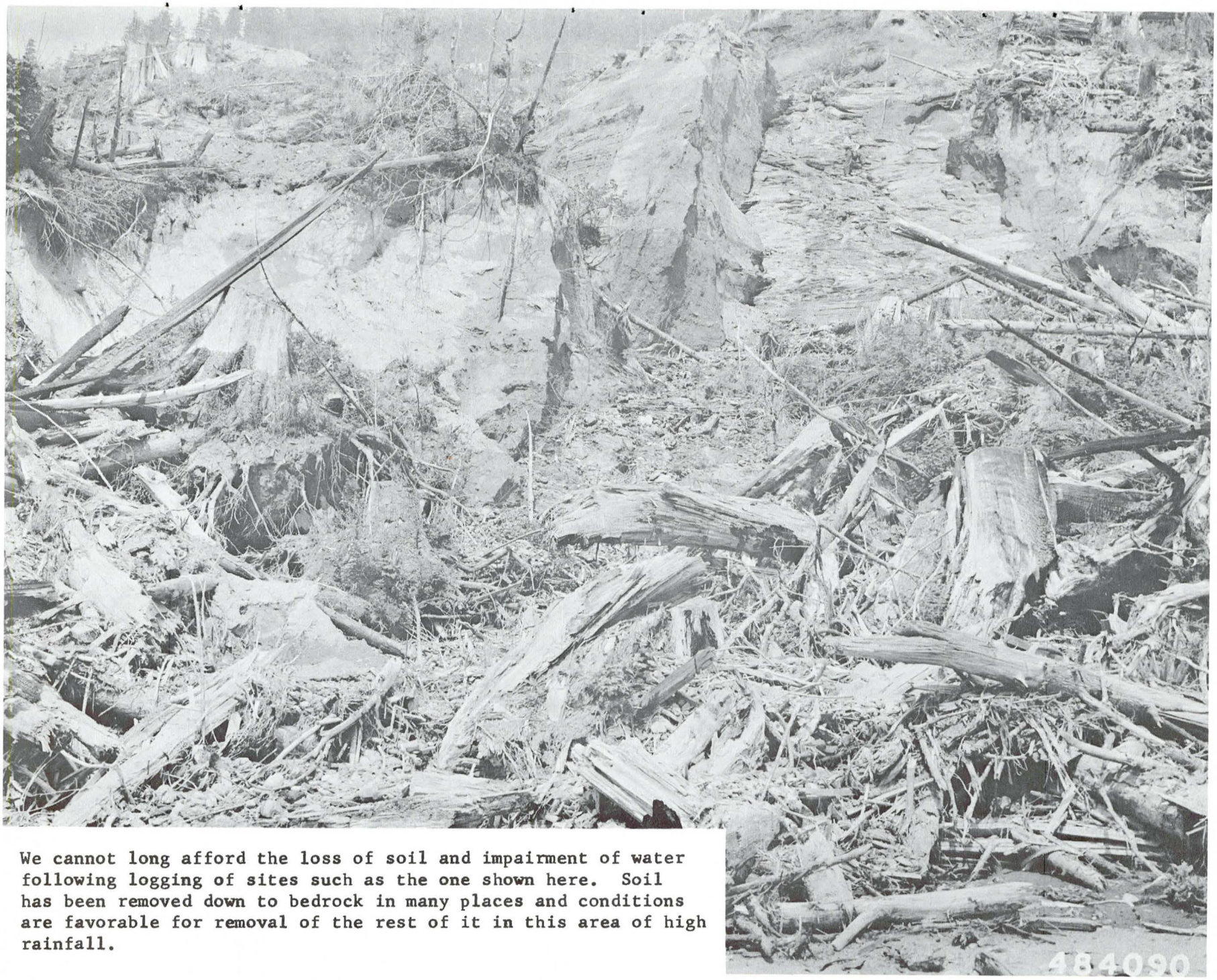
High water removed this temporary bridge at lower end of clear-cut area. Less soil would have been disturbed had the bridge been removed when sale was closed.

Ponderosa pine grows best on deep, fertile, well-drained soil with ample precipitation.

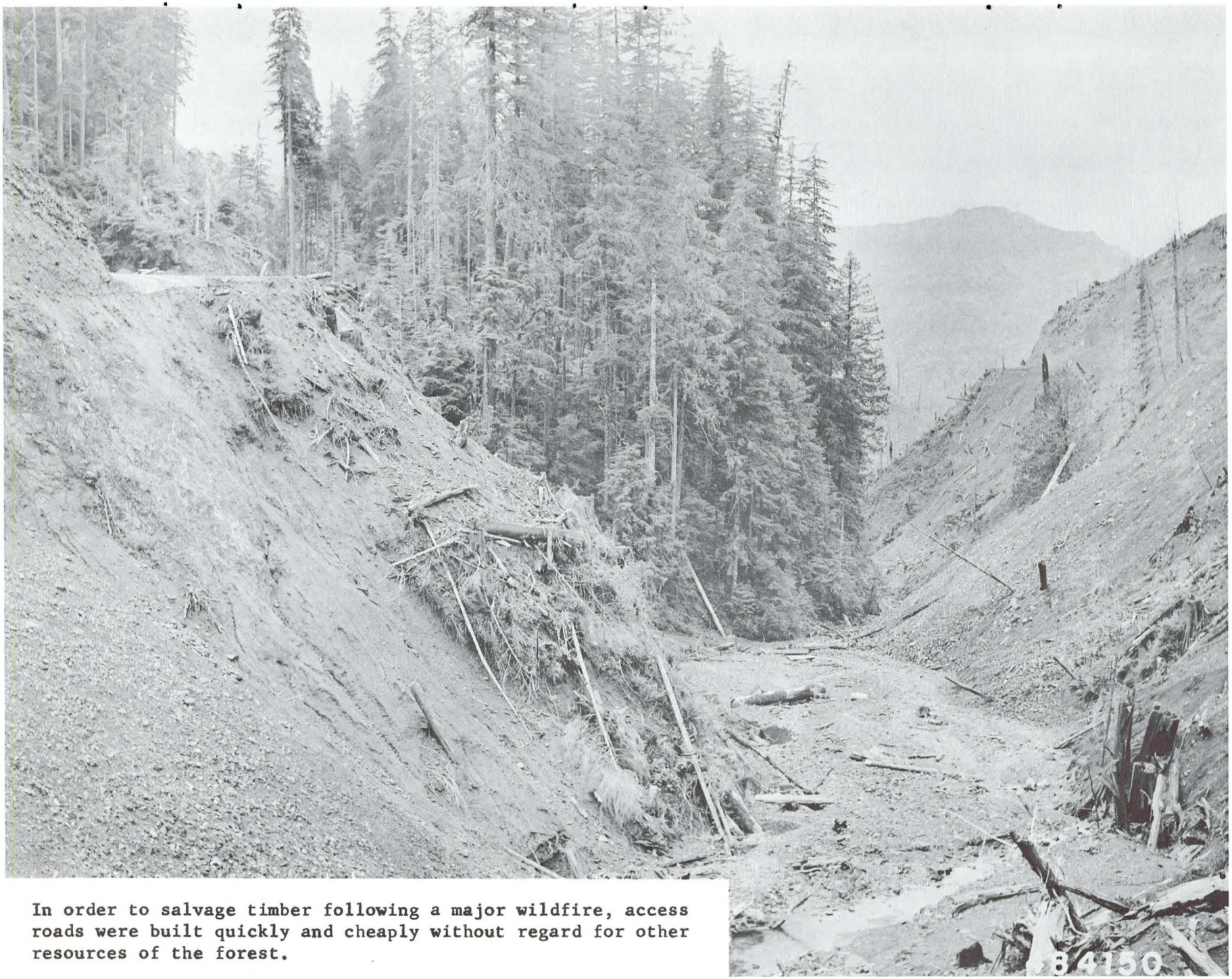


Timber can be harvested without undue impairment of soil and water values if proper precautions are planned for and followed.

Debris in the foreground was carried by water from one storm. There were no restrictions on logging methods in the forest where the trees grew. Water is flowing over, through and under the debris. Mr. Hayes, who is 6' 3" tall, gives indication of volume of debris.



We cannot long afford the loss of soil and impairment of water following logging of sites such as the one shown here. Soil has been removed down to bedrock in many places and conditions are favorable for removal of the rest of it in this area of high rainfall.

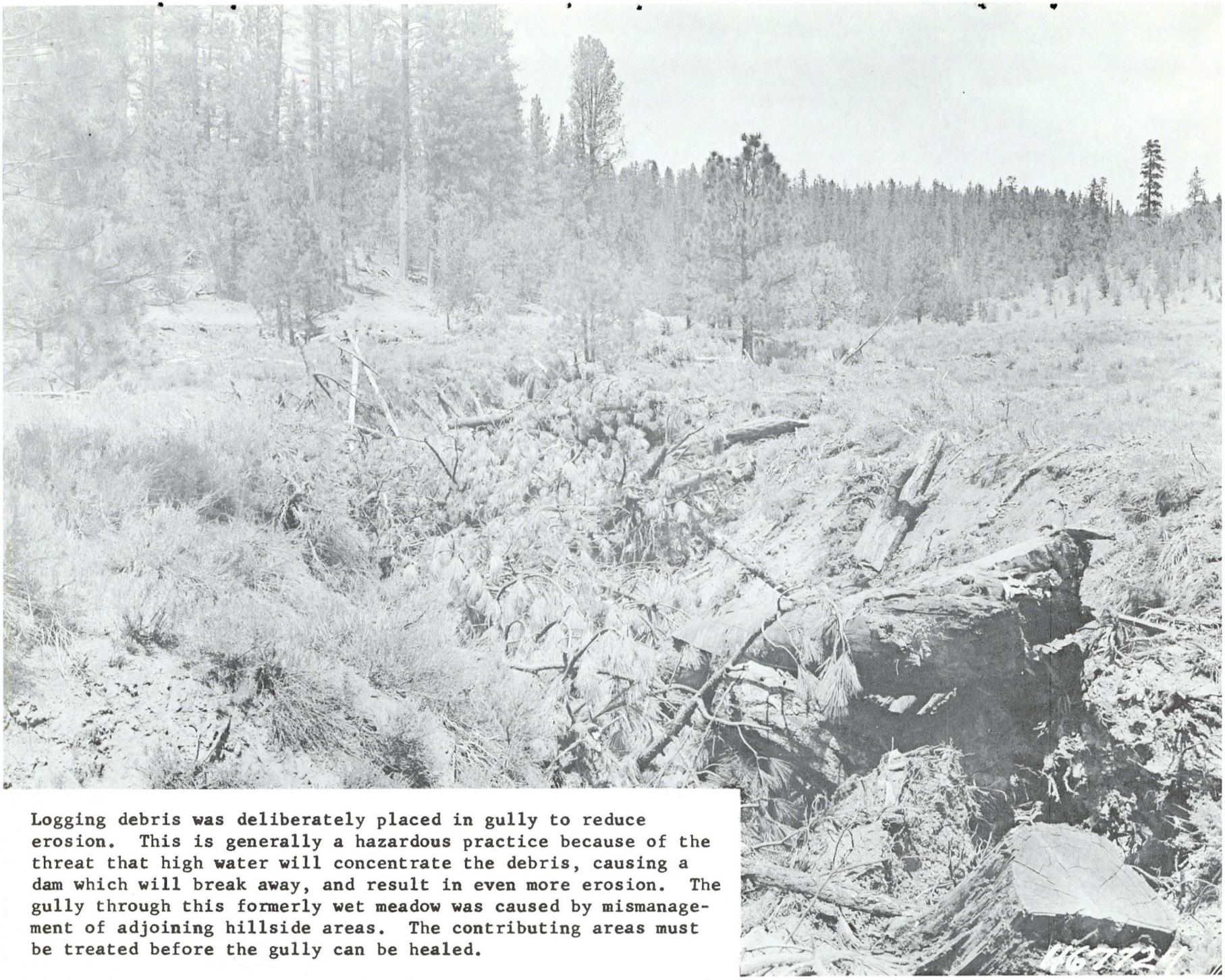


In order to salvage timber following a major wildfire, access roads were built quickly and cheaply without regard for other resources of the forest.

Uncontrolled water traveled several hundred yards down this skidtrail. Water diversion and reseeding to grasses ordinarily prevent excessive soil movement in this relatively unstable area.

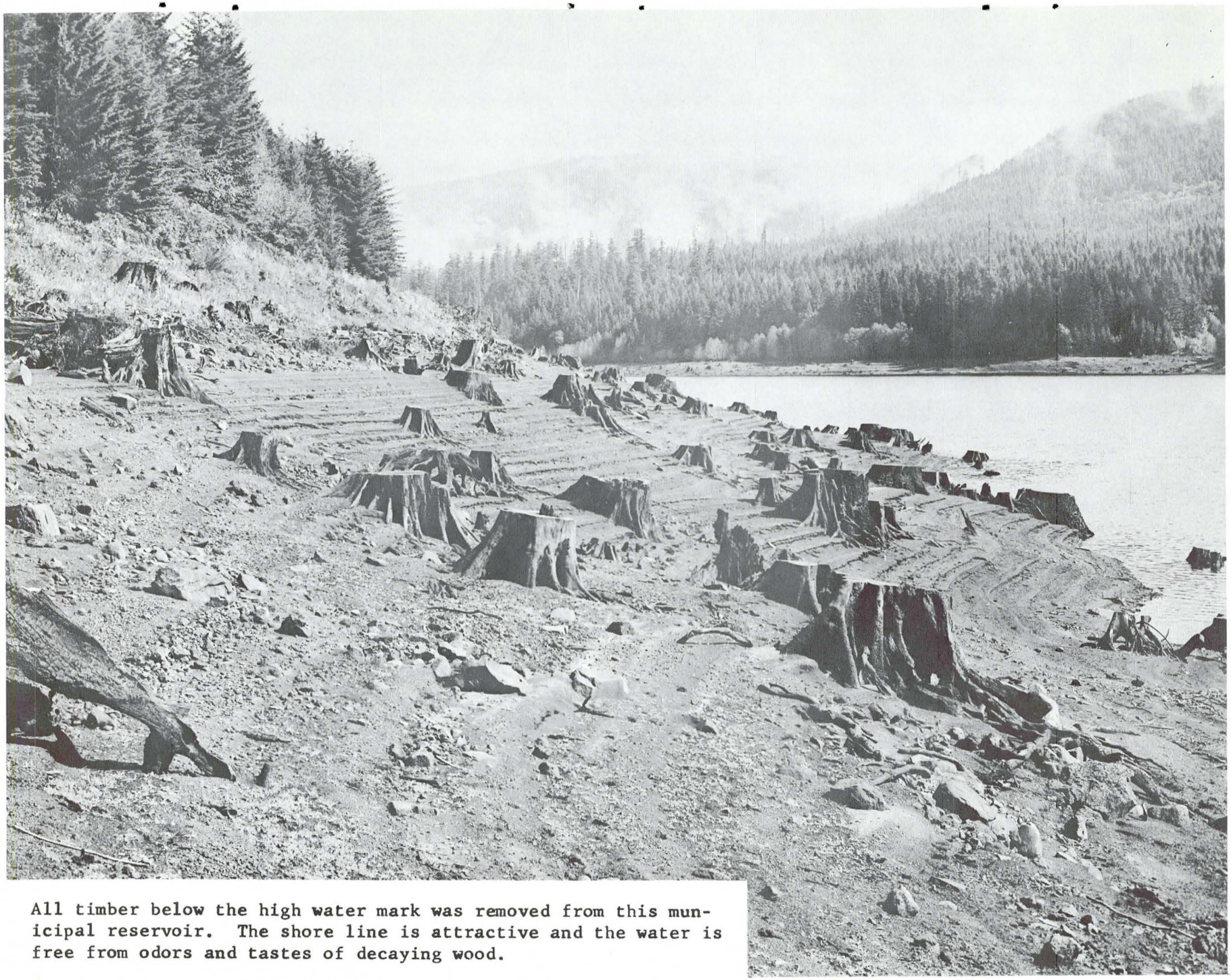
Before logs were skidded down this trail, the trickle of water from the right flowed to a stream at left. The skidtrail diverted the water, causing the movement of many tons of soil to foul the stream.

This undrained spur road will continue to cause soil to be carried to the nearest stream.



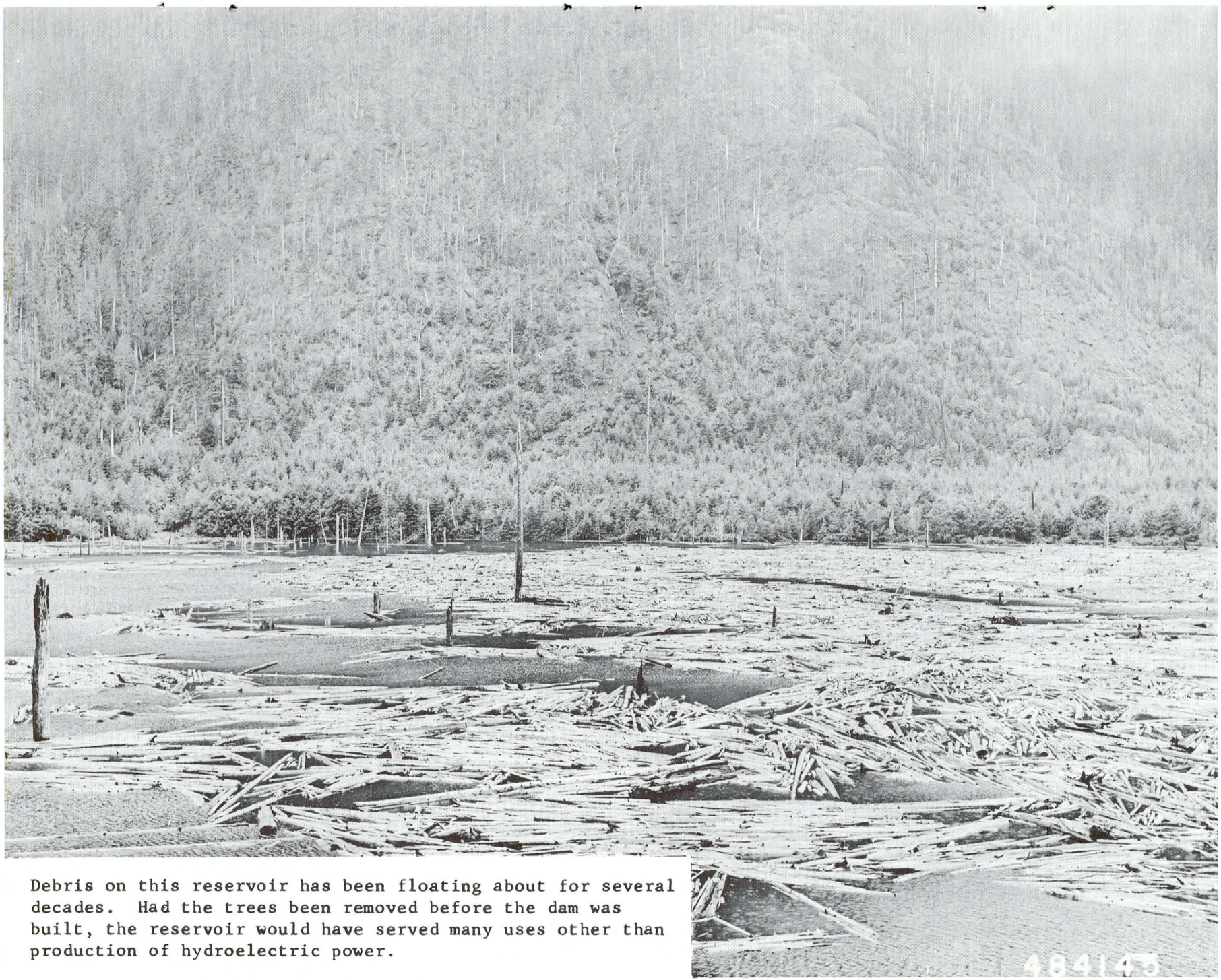
Logging debris was deliberately placed in gully to reduce erosion. This is generally a hazardous practice because of the threat that high water will concentrate the debris, causing a dam which will break away, and result in even more erosion. The gully through this formerly wet meadow was caused by mismanagement of adjoining hillside areas. The contributing areas must be treated before the gully can be healed.

A dam was installed at the outlet of a natural lake to provide more water for a hydroelectric plant. The power company was not required to remove the surrounding timber which grew on the area to be flooded. The resultant debris reduced the value of the lake for recreation use and fish production.

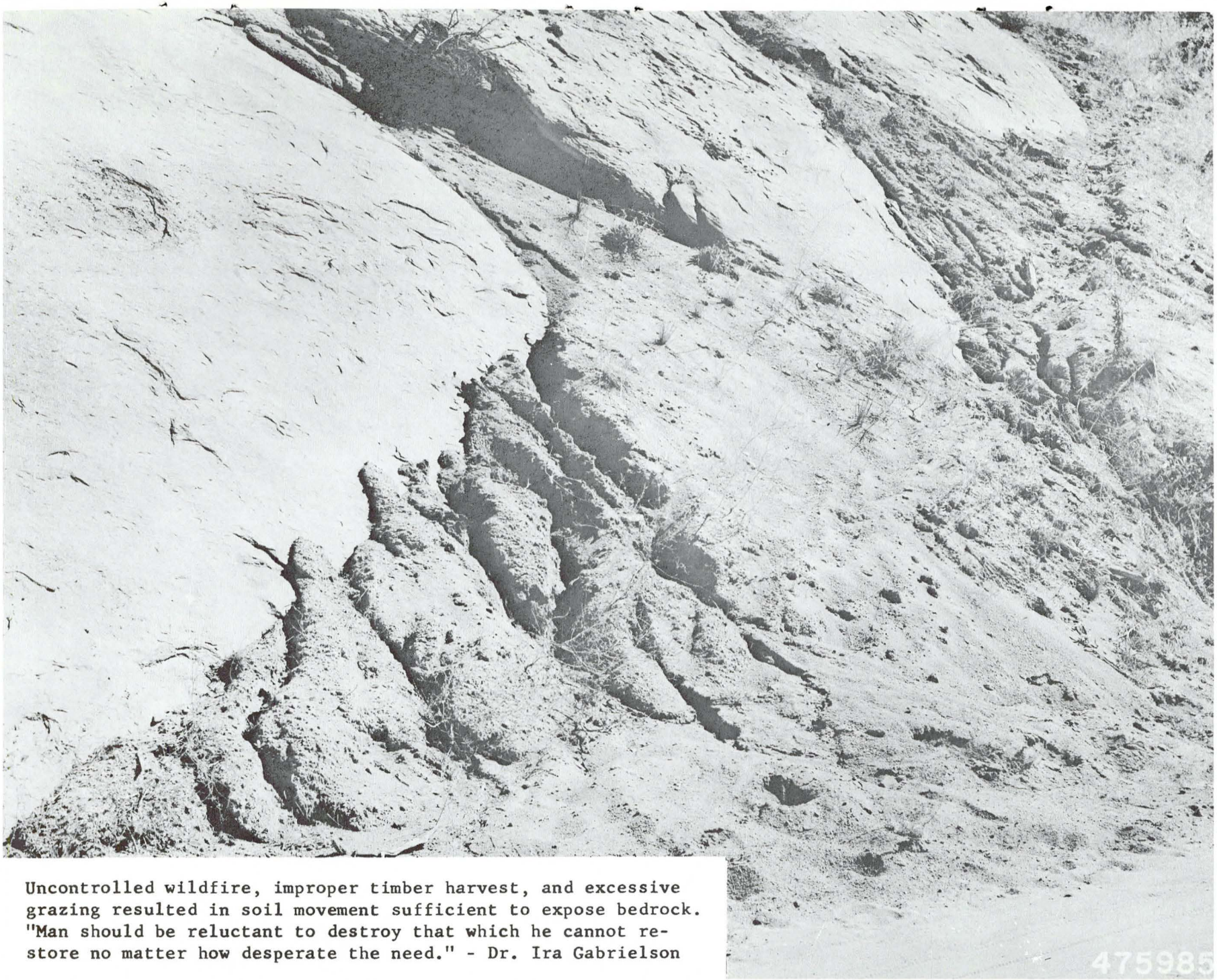


All timber below the high water mark was removed from this municipal reservoir. The shore line is attractive and the water is free from odors and tastes of decaying wood.

The value of this reservoir for purposes other than water storage for irrigation has been impaired because timber was not removed from the site prior to flooding.



Debris on this reservoir has been floating about for several decades. Had the trees been removed before the dam was built, the reservoir would have served many uses other than production of hydroelectric power.



Uncontrolled wildfire, improper timber harvest, and excessive grazing resulted in soil movement sufficient to expose bedrock. "Man should be reluctant to destroy that which he cannot restore no matter how desperate the need." - Dr. Ira Gabrielson

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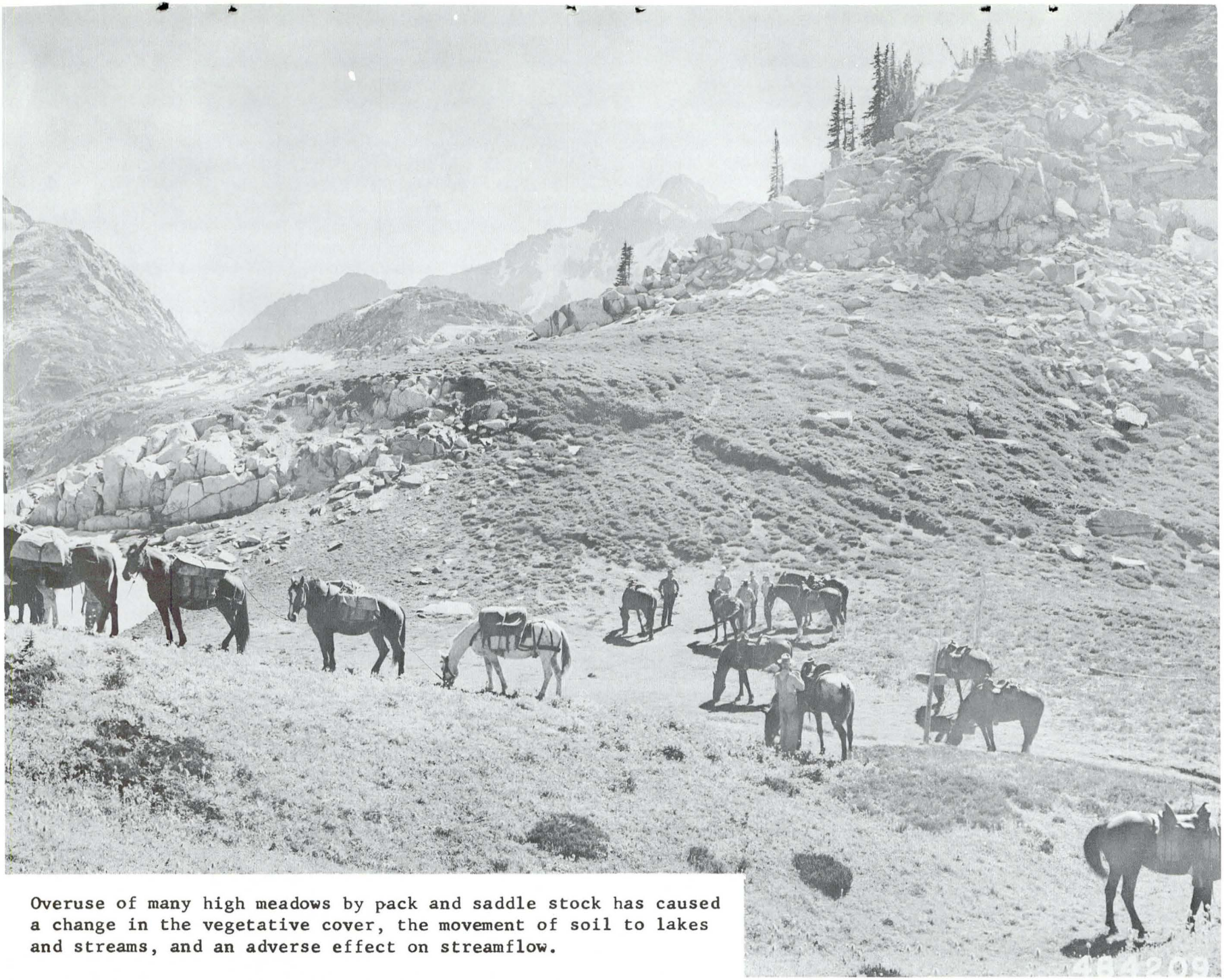

Overuse of many high meadows by pack and saddle stock has caused a change in the vegetative cover, the movement of soil to lakes and streams, and an adverse effect on streamflow.

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